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TECH JOURNAL

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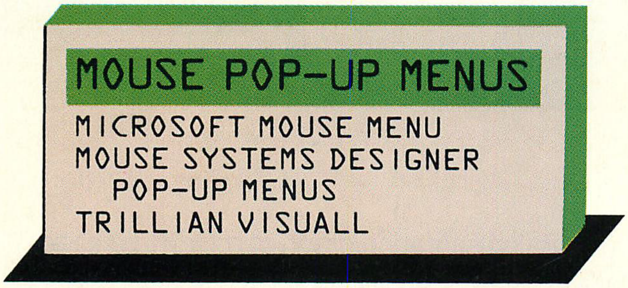

MOUSE POP-UP MENUS TESTED AND REVIEWED

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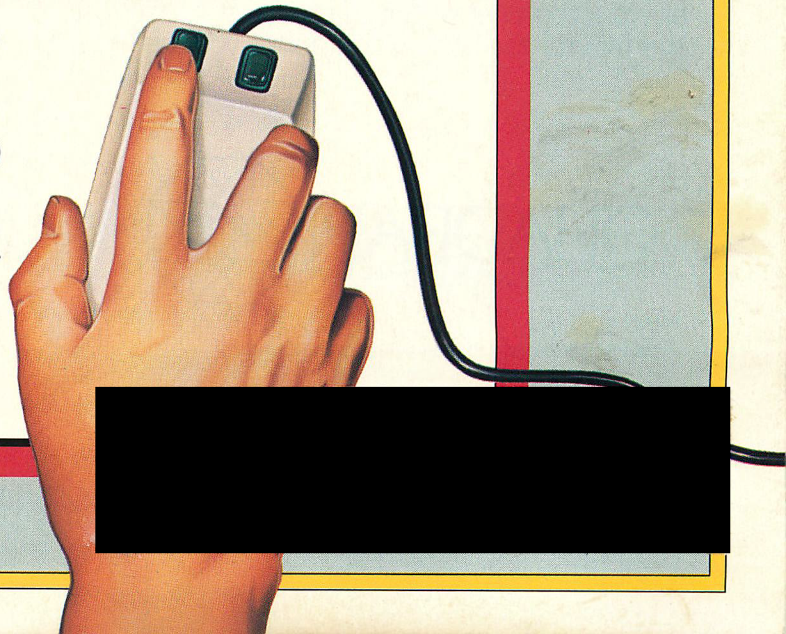

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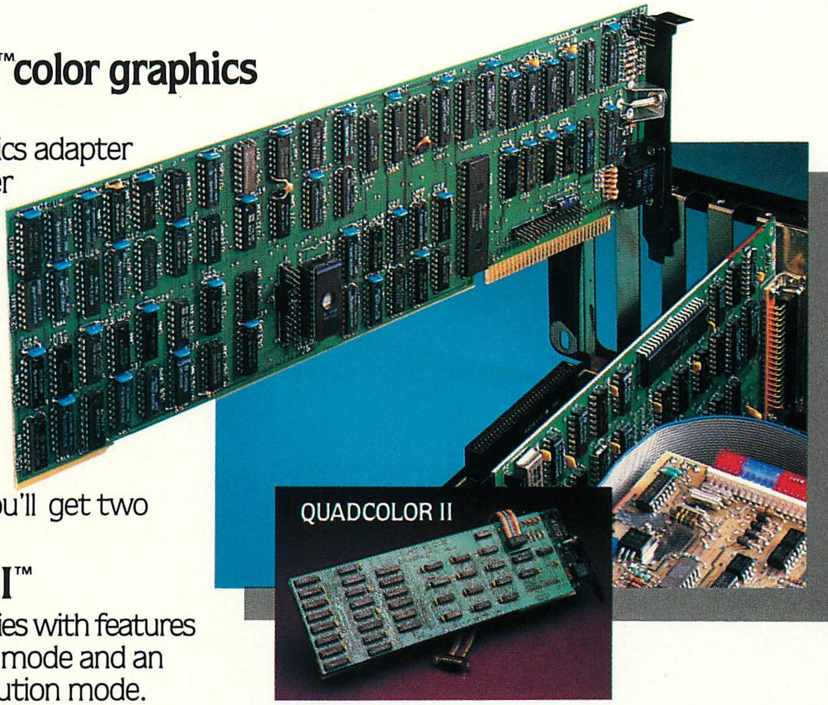

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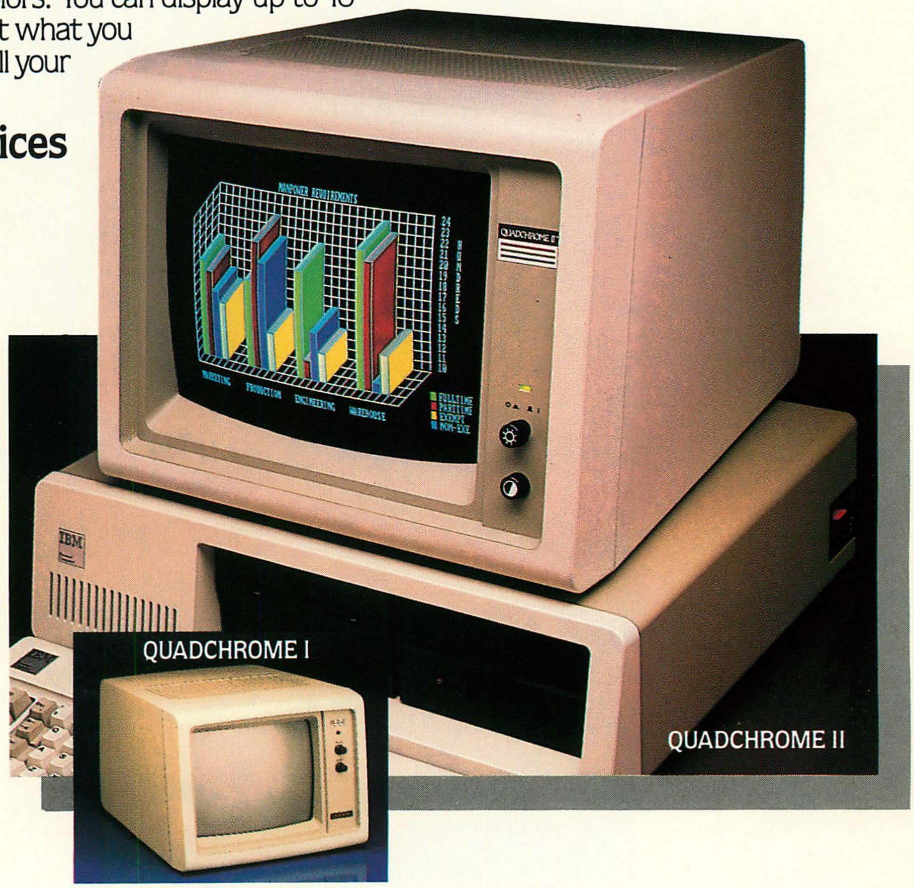

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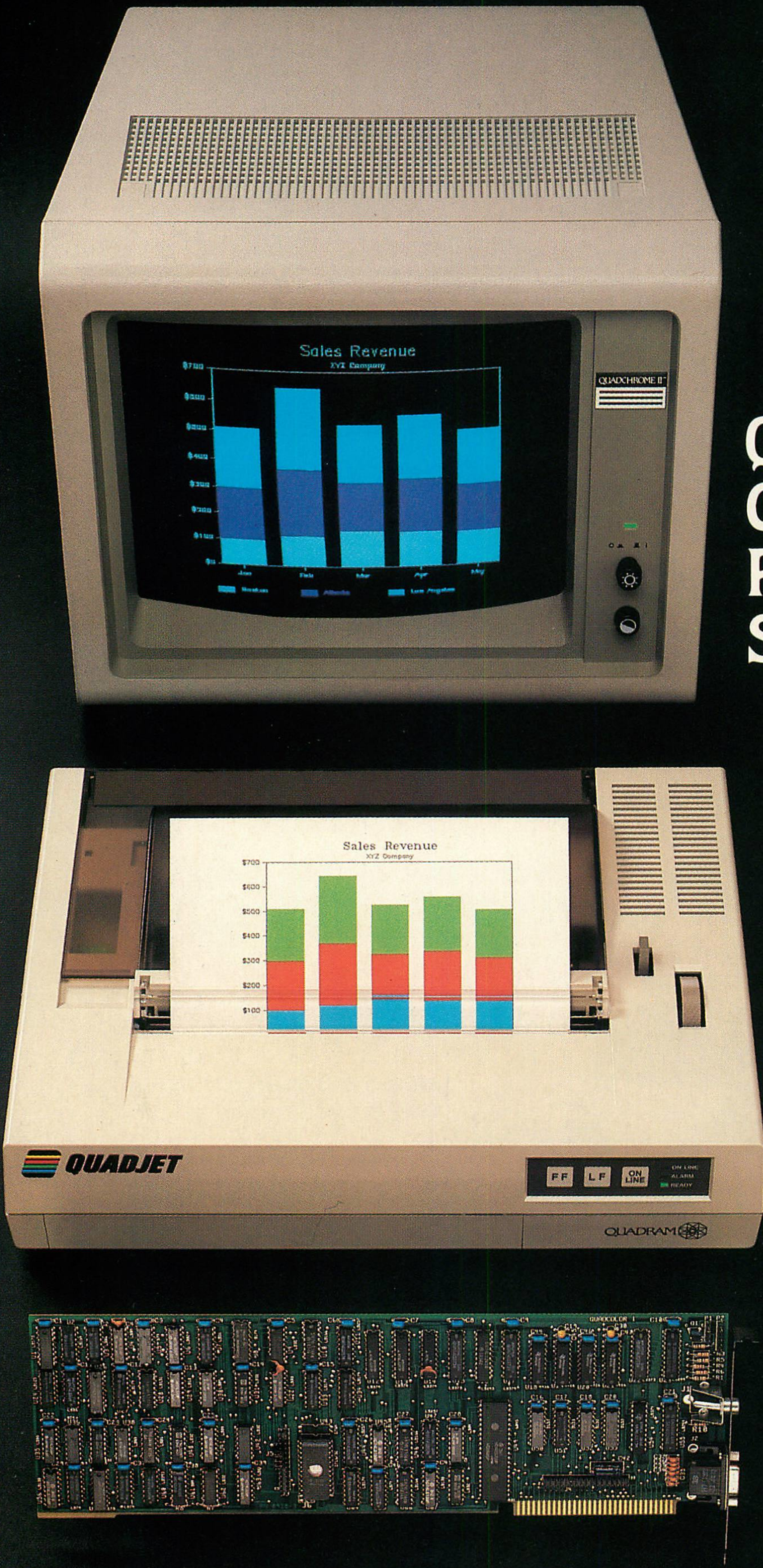

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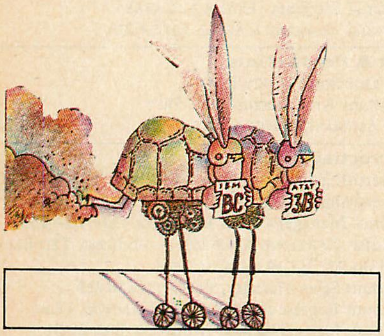

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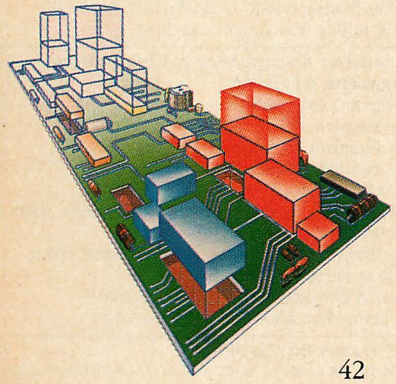

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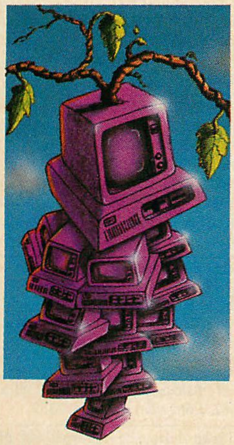

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Mice Are Nice

. . . but performance is the key

To mouse or not to mouse? That has become one of the burning questions in the continuing saga of the man-machine interface.

Mice have been with us for about 20 years. Credit is usually given to Doug Englebart at SRI, who invented a mechanical mouse driven by wheels. Since then, there have been a number of innovations, including the replacement of the wheels with a single ball bearing and, more recently, the development of optical mice. In the late 1970s, mice began to creep into the collective consciousness of the computer industry, and by the early 1980s more than one mouse was available commercially.

Two events were probably responsible for making the mouse so highly visible and of such widespread general interest. The first was Xerox's announcement of the Star, an icon-based system with a high-resolution graphics display and, of course, a mouse. The machine was slick and sexy, and it drew crowds whenever it was displayed. But if the first event was like a stick of dynamite, the second was an atom bomb: Apple announced Macintosh, complete with a mouse as a standard feature.

But that's strange. Mice for the PC and other computers became available and affordable long before Mac was announced. What was it about Mac that made mice so visible, attractive, and desirable?

The answer is simple: MacPaint. A simple answer, yes, but a most important one to understand.

MacPaint

What this Mac program did was to demonstrate for the first time a clear, utilitarian reason to use a mouse. MacPaint and the mouse are just made for each other; it's a brilliant combination. And the marketing folks at Apple think so too: MacPaint is selling its fair share of Macs, all by itself. I won't bore you with the details, but if you want a good time, call your local Apple dealer and get a Mac demo.

As for the importance of MacPaint on Macintosh, we'll return to that issue in a minute.

Are Mice Good for Anything?

Now that mice are so visible and are attracting even the mass-market consumer, the controversy over their usefulness has become something just short of violent.

On the one hand, Apple and others are arguing that a mouse makes it possible and simple to *point* at things and that this makes a computer easy to approach (because we already know how to point) and to use (because we are such expert pointers, having had years of prior experience). This is a strong argument. To be convinced of this, just watch as a neophyte marches through the 10-minute Mac tutorial, gains confidence, then operates one of the Mac programs with moderate, if hesitant, facility.

On the other hand, many people, especially those in the text-processing industry or those selling computers without mice, argue that many of the tasks for which a computer is used are text- or number-oriented. In other words, typing is still essential and the mouse is no help at all. Furthermore, some argue that a mouse in such circumstances is actually detrimental, because to activate a mouse-driven function the user must remove at least one hand from the keyboard and place it on the mouse; such a move, they argue, is a distraction. These points are well taken.

Is a mouse good for anything? My answer is yes. I think a mouse is perfect for two types of activities. First, it is terrific for graphics applications as long as the resolution is not very high. The moderate resolutions of the PC and the somewhat greater resolution of the Mac are manageable; the MacPaint software provides a zoom that allows dot-by-dot precision. Again, a MacPaint demonstration should remove any doubts that anyone might harbor about this assertion.

I refer to the second activity as *marking*, and I define it as the act of identifying for the computer a "thing" upon which you would like the program to act. In a graphics application, for example, you might want a region tiled with a pattern or a section erased. You might identify the endpoints of a line or the corners of a box to be drawn. In a text application, you might mark words, sentences, paragraphs, or arbitrary blocks of text for removal, relocation, or special formatting such as underlining, bold, or italics. In a spreadsheet,

you might mark areas that need copying or recalculation.

Nothing can beat the mouse for marking. This is almost a certainty for graphics applications, although other devices (joysticks, digitizers, trackballs) have been used for many years with much success. It is less obvious with text applications, but I think mice have equal application here as well.

Menus

There is one area in which I doubt that mice are effective, and it happens to be the one use for which they have been most highly touted: pop-up/pull-down menus.

Menus are highly desirable in a complex system that is used by a novice. Once the novice is trained, however, menus tend to slow things down. Many people have said that the use of a mouse avoids this problem, but here, for the first time in the controversy, I strongly disagree. And it is here that we can begin to see some of the problems associated with mice.

Unlike the keyboard, which is a collection of discrete buttons in well-defined and regular positions (let's talk about the slash key some other time, folks), the mouse is almost an analog device. It is easy to train yourself to home in on a control key combination and eventually to be able to do so without looking. If you are a touch typist, such training is even easier. With a mouse, however, you have to grasp the mouse, move the cursor to an appropriate position, and press a button. Simple? Yes, but it requires one thing that use of the keyboard does not: *eye-hand coordination*.

I know what you're thinking. "We do that all the time! Piece of cake!" Well, I'm sorry, but you don't. Sure, if you are moving the cursor under the letters in a sentence it helps if you coordinate the activity visually. But there are many times when you quickly assess how many positions you have to move and then count them out without having to look. Try it sometime. Do you really watch to see if the cursor moves left three columns on the spreadsheet, or do you just instantly, almost without thinking, smash the left arrow key?

And consider menus. Most well-built menu systems offer expert options that allow the user to invoke the menu with a single keystroke, spy the selection desired, and then, usually without looking, strike the next key to get the desired effect. That's why expert WordStar users can make things happen so quickly. In fact, even though its choices for keys are completely obscure, WordStar has some well-considered human factors.

How about the mouse? Can you count? No. It is *imperative* that you be looking all the time to verify that the movement of the cursor matches your intentions. Can you just pick off a menu selection? Nope. Again, you must carefully coordinate your hand movement with visual feedback to move the cursor to the right place on the list of choices. In short, the process is slow and tiring for the long haul.

"But wait a minute, Will. If it's okay for marking, why not for selecting?" The answer is simple. Selecting requires precision movements at every step; marking requires precision only at the beginning and end. No other technology I know (at the price, that is) offers the combination of precision and speed that marking requires.

Performance

One other consideration that will make or break mice has little or nothing to do with the mouse itself.

For ultimate acceptance, a program using mice must make the mouse perform well. For one thing, the cursor must be rock-steady if the mouse is not moving, and minor oscillations must be dampened or filtered out. For another, the cursor must move smoothly and with sufficient resolution that any point passed (for example, on a curve) can register. The cursor must never lag behind the mouse, so the driver software must be able to get the mouse movement to the cursor-update routine instantly. Finally, the cursor must move in real time, regardless of the state of the application program.

Performance and responsiveness that meet these criteria will make mice an accepted peripheral on small computers, even when they are used in conjunction with text or numeric applications.

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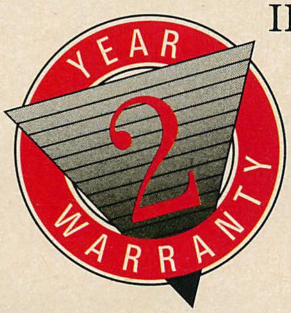

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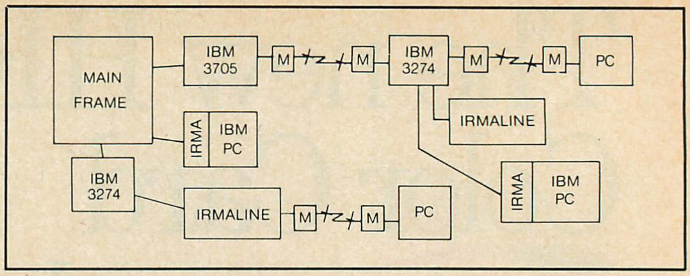

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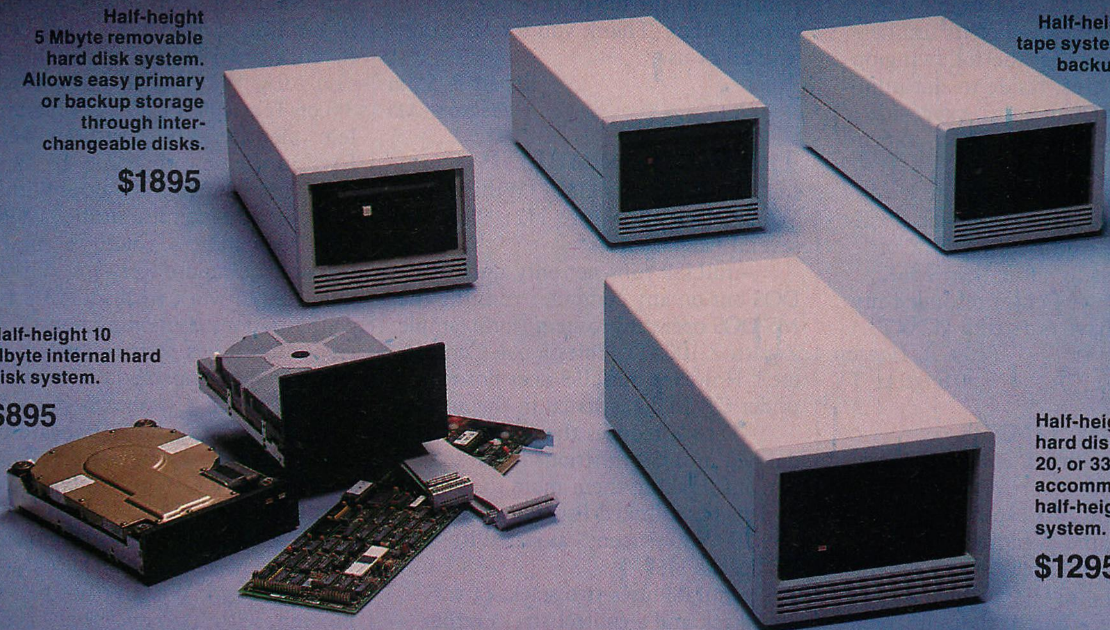

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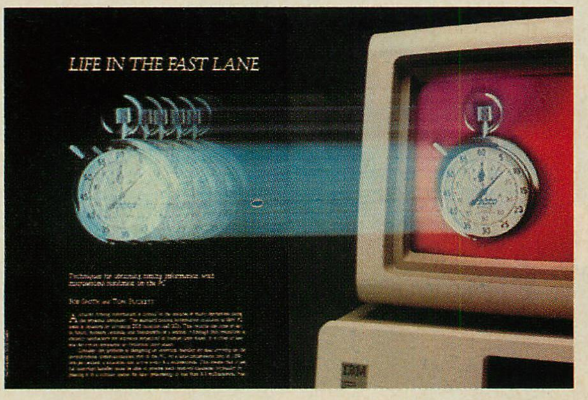

Portable's Complaint

I purchased an IBM PC Portable and had to return it because of its limitations. IBM states that the following options, if used, must reside in slot number two: 64/256K memory expansion option; IBM PC cluster adapter; expansion unit 001 hard disk.

Therefore, if you want the hard disk you cannot have more than 256K of memory, i.e., no PC/IX UNIX or any program using more than 256K. The IBM Product Center refunded my money and I have ordered a PC/XT.

Peter A. Hanson
Arlington, TX

The Best of Timers

I am writing to thank Bob Smith and Tom Puckett for their wonderful article, "Life in the Fast Lane" (April 1984, page 62). Like me, hundreds of others should find useful applications for the technique the article explained so well. After all, time is one of the fundamental units of measure.

The technique the authors described served me well in the following application. I needed a way to produce a repetitive event at a smooth rate of once every one-hundreth of a second. Using only the BIOS timer it was not possible to repeat the event smoothly because of the lower resolution of the timer. Using the low-order extension from the programmable interval timer, it was possible to regulate repetitive events even at speeds nearing CPU execution speeds.

The alternative method of using carefully designed delay loops for timing purposes has a number of disadvantages. The two main ones are the inability to do any other useful work while the delay loop is executing, and the fact that external interruptions take time, too, and cause the delay loop to delay longer than expected.

This timing technique is going to remain near the top of my programming toolbox. Thank you for bringing it to all of us.

Robert B. Stam
Jackson, MS

The Facts on muLISP

In "The PC Speaks LISP" (William G. Wong, April 1984, page 112), there are several factual errors:

-muLISP runs not only under PC-DOS but on any computer running the MS-DOS operating system (for example, Zenith Z-100, TI Professional, Compaq, etc.). However, muLISP does *not* run under CP/M-86 as stated in the article.

-D-code reduces the size of user-defined muLISP functions by 50 to 60 percent (making them more than twice as dense as a linked list) rather than "by 20 to 35 percent" as stated in "The PC Speaks LISP."

-muLISP uses two stacks (a variable stack and a control stack) rather than three. The control stack uses the 8086/88 hardware stack to store references to d-code and return addresses.

Albert D. Rich
Applied logician
The Soft Warehouse
Honolulu, HI

Mr. Rich also pointed out in his letter that the correct address for The Soft Warehouse is P.O. Box 11174, Honolulu, HI 96828; and for Microsoft, 10700 Northup Way, Bellevue, WA 98009. He further observed that the current version of muLISP resolves many of the deficiencies described in the article. The newer version, muLISP-83, will be considered for review at a later date.

Mouse Tale Revised

The Mouse Systems software reviewed in "A Tale of Two Mice" (Jeff Duntemann, April 1984, page 150), was version 2.0A. We released a new version, 3.0 on February 15, 1984. Some problems mentioned in the review were fixed in the new version.

The reported difficulties with some asynchronous communications adapters have been addressed with the new release of the mouse software. We are now able to work with more PC system configurations containing nonstandard communications ports or modem cards. We have been unable to test the new software on an Ultraboard, but we believe that even if the Ultraboard port does not work as a mouse port, another port in such a system will work as either COM1: or COM2:.

The jumpy cursor problem in the Microsoft Mouse emulator, MSMOUSE, has been fixed. We have not had a problem with high-resolution mode.

There was some confusion about the Microsoft and Lattice C compiler interface information for MouseWindow being available by request from us. The interface information is for MSMOUSE and is included in the current manual. Users with earlier versions of the product can get the information from us at no charge.

We released a new version of MouseWindow, 2.0, in April. One new feature of MouseWindow is language support for the Microsoft and Lattice C compilers. Numerous other features have been added, including automatic cursor tracking, event queue processing, color support, and additional graphics adapter support.

The problem of garbage appearing on the screen while moving the mouse in WordStar is a WordStar "feature." WordStar apparently cannot handle large amounts of repeated cursor move-

LETTERS

ment. The mouse software can generate keystrokes faster than the "auto-repeat" feature of the standard IBM keyboard handler. We are investigating ways to provide the option of limiting the mouse keyboard input rate in order to work better with WordStar and other programs that cannot handle high volumes of keyboard type-ahead.

Eileen S. Milligan
Customer Service Manager
Mouse Systems
Santa Clara, CA

Thanks for your recent article "A Tale of Two Mice," which was of great interest to us at LOGITECH. I would like to commend you on several points and correct you on one or two others.

I appreciated your enthusiasm about the mouse, which is the easiest input device to use and the most efficient way to position the pointer on the screen. I also appreciated your observation that Microsoft should be the standard for mouse interface software. We agree and have developed a driver for our mice that makes them completely Microsoft-compatible.

I must take issue with your description of the Microsoft Mouse, however. You describe a mouse that uses mechanical tracking and optical decoding—a perfect description of the optomechanical LOGIMOUSE. Microsoft's mouse is electromechanical, a disadvantage for both wear and tear and resolution. The optomechanical LOGIMOUSE mouse can be guaranteed for more than three times the mileage and more than twice the resolution of any other mouse on the market.

You describe the Xerox mouse as looking "complicated and fragile" inside. Please look inside our mouse. We are proud of how elegantly simple and rugged it is inside and out.

Thanks again for your article. We will look forward to more mouse news from you in the future.

Pierluigi Zappacosta
President
LOGITECH, Inc.
Redwood City, CA

Disk Drive Dilemma

As a charter subscriber to *PC Tech Journal* and a long-time IBM PC owner, I am now faced with the necessity of replacing the single-sided disk drives in my unit with double-sided ones. In the process of deciding how to do this I made a surprising discovery.

Apparently the major manufacturers of floppy disk drives have never advertised in any of the half-dozen computer magazines I receive, nor have their products ever appeared in new product announcements. I have spent several hours searching for mailing addresses for Tandon, Teac, and Panasonic without finding any. They also do not appear in my *National Directory of Addresses and Telephone Numbers* or the *Industrial Research and Development Telephone Directory*.

The nearest computer dealer from here is a 60-mile round trip or a $2 toll call, so I depend on magazines and mail order. The mail-order houses' advertisements list a bewildering variety of part numbers with no descriptions, and the girls at the 800 numbers know nothing about what they mean. I haven't seen any detailed articles on the selection and replacement of PC disk drives.

It seems that you could provide a real service to your readers if you would: (1) publish articles devoted to the disk drive replacement problems that must affect thousands of people who purchased the original IBM complement of equipment; (2) publish a personal computer industry directory with names, addresses, and telephone numbers of all major suppliers of PC-related equipment so people like me can write for detailed product descriptions and catalogues.

I am sure many of your readers would find this information useful.

Michael W. Csontos
Lima, NY

The manufacturers of diskette drives usually do not advertise their wares directly. Instead, third-party distributors make the products available. You will find a number of such companies represented in the advertisements in this issue of PC Tech Journal.

A number of buying guides have been published, including our own PC: The Buyers Guide. *You can get your own for $7.95 (plus $1 shipping and handling, $13 outside the U.S.). You will find it in many book and computer stores, or write* PC: The Buyers Guide, *P.O. Box 555, Morris Plains NJ 07950.*

—WF

"Missed the Mark, Chaps"

I read your magazine here in the good old U.K. with the greatest of interest, as we have nothing to match it for in-depth technical content about all things related to the IBM PC. It was therefore with great amusement that I read your comments on the micro market in the U.K. ("The Tech Journal Newsline,"

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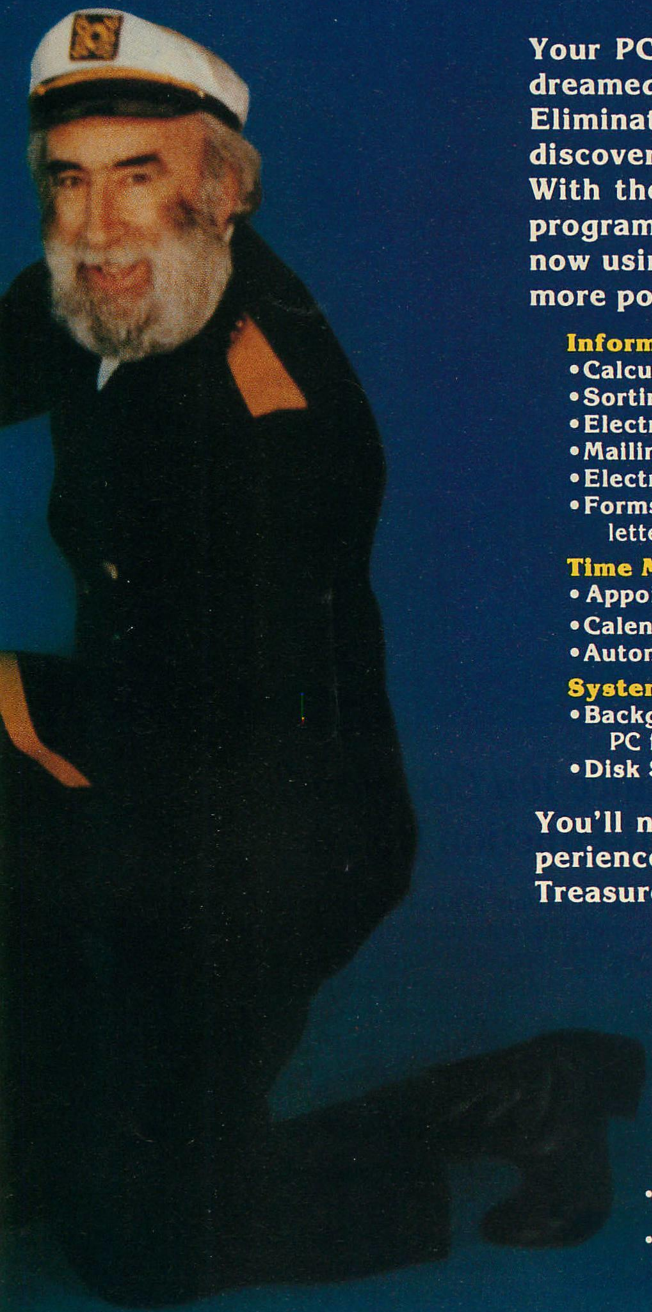

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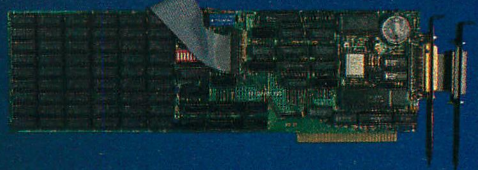

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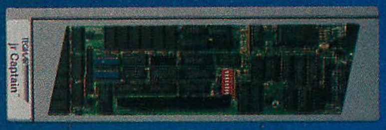

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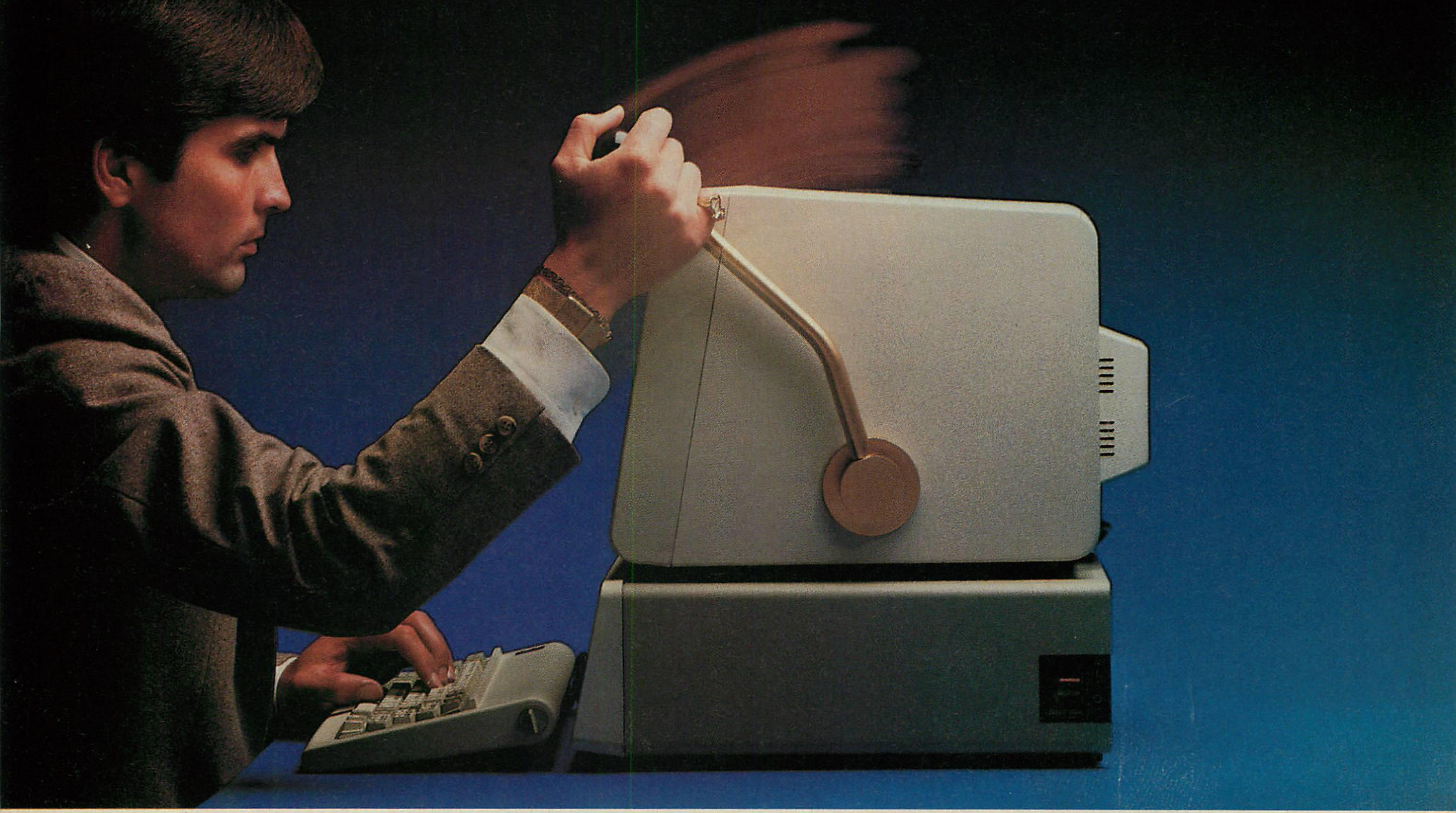

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Sol Libes, March 1984, page 28). I am afraid that, although you get top marks for most areas, you missed the mark by a long way in this short article.

Yes, IBM PCs are primarily sold to the business user. No, they are not all used as terminals to large mainframes (some are). Most are used with productivity software such as Lotus 1-2-3, Multiplan, and Multimate, or in small companies for sales ledgers, etc.

No, the Sirius machine (Victor 9000) is not the most popular desktop system. That place is almost certainly occupied by the IBM PC. The reason it is reported otherwise is that only sales via retail outlets other than IBM retail centres are included in published figures, which exclude all sales via IBM's VPA program and via IBM retail centres—a substantial number of the total IBM PC sales in this country.

Yes, we have active PC User Groups, the largest of which has active branches all over the country.

Yes, most of the packaged general application software is U.S.-produced (most U.K. software tends to be vertical market packages). No, it does not take typically six months before packages become available; the mainline software tends to hit our shore within a month of it being actually available in the U.S. (à la Lotus, Microsoft, Ashton-Tate, Microrim, MicroPro). I stress the *actually available* software as there seems a tendency in the U.S. to pre-advertise software heavily. The only notable exception to this availability is IBM itself.

Of all the statements in this article, the most misleading was that the Apple /// is more popular than the Apple IIe. You obviously have not talked to Apple on this one (or if you have they gave you the wrong information). The Apple IIe outsells the Apple /// by at least fifty to one.

I hope that this letter is taken the way it is meant. It is just that there appears to be an epidemic of articles in U.S. magazines stating how backward in the micro field we are in the U.K.

C. Budgen
P&P Micro Distributors
London, England
San Jose, CA

Mathematical Notes

Upon reading Michael Linley's reply (February 1984, page 22) to Amr Razzak's letter (November/December 1983, page 26) complaining about the hexadecimal notation used in "The IBM Color/Graphics Adapter" (Thomas V. Hoffman, July/August 1983, page 26), I

SOFTWARE DEVELOPERS

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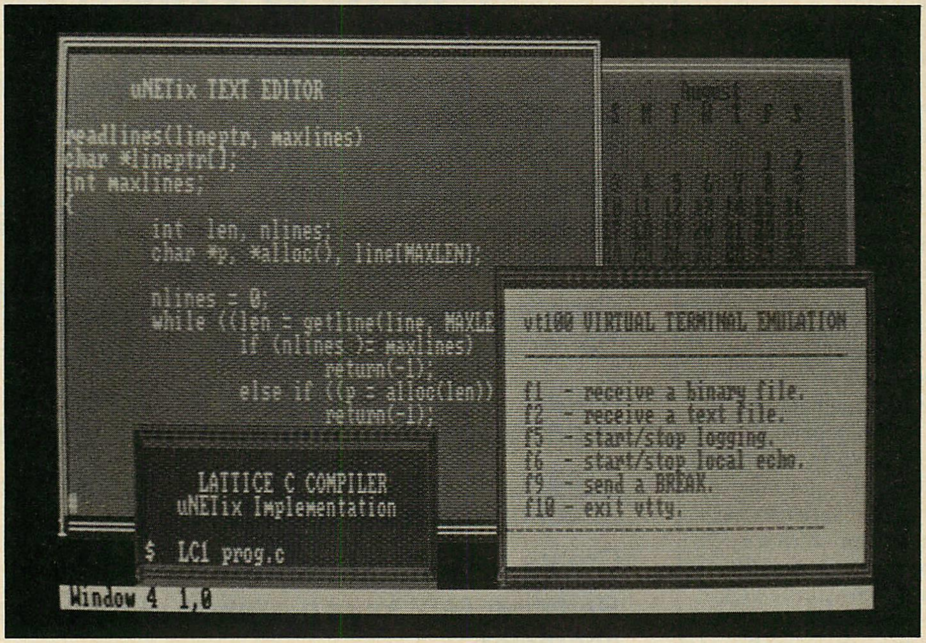

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                                    CX=0000     SI=0000     ES=1985
                                    DX=1138     DI=0000     CS=2001
               PL ZR  NC NV  UP  NA PE  EI                  IP=0001
2001:0000   53              24 IO_INIT:  PUSH   BX                          ;TAG A LINE
2001:0001   9BDEC2                       FADDP  ST(2),ST
2001:0004   BB3100                       MOV    BX,Offset VECTOR_TABLE_2
2001:0007   803E5E~         34           CMP    DOS_VERSION_NUM,'2'         ;BREAKPOINT SET
2001:000C   7305                         JAE    TRASH_IT
2001:000E   BB0100                       MOV    BX,Offset VECTOR_TABLE_1
2001:0011   EB02                         JMP    Short LONG_LABELS_ARE_OK_AS_YOU_LIKE
2001:0013   F2AB    00777   TRASH_IT:    REPNZ  STOSW                       ;STOP 777th TIME
2001:0015                   LONG LABELS_ARE_OK_AS_YOU_LIKE:
2001:0015   8DAD63-                      LEA    BP,WIERD_CODE + 2[DI]
2001:0019   240C                         AND    AL,00011100B                ;CHANGE RADIX
2001:001B   45                           DB     69
                      MEMORY DUMP
>>DOS_VERSION_NUM          Absolute Address=03C9E   Segment:Offset=03C4:005E
1984:0050    41 53 43 49 49 20 53 55-50 50 4F 52 54 20 32 20   ASCII SUPPORT 2
1984:0060    20 2D 2D 20 43 6F 64 65-53 6D 69 74 68 2D 38 36    -- CodeSmith-86
1984:0070    20 4D 41 4B 45 53 20 44-45 42 55 47 47 49 4E 47    MAKES DEBUGGING
1984:0080    20 41 20 42 4C 41 53 54-21 20 20 20 20 20 20 20    A BLAST!
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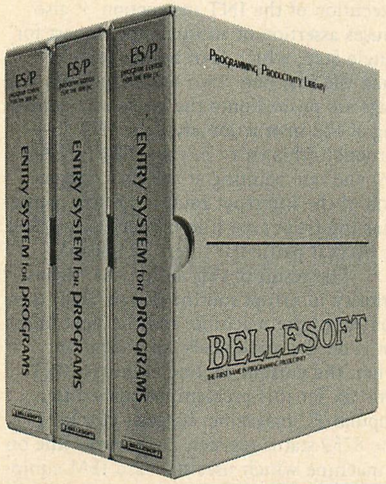

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went back and read the original letter and noticed something interesting. Your reply to Razzak's letter stated that you use the notation of whichever computer language is used by the article because there is no "standard" notation.

There *is* a standard notation for nondecimal numbers. In mathematics, such a number is written with a subscript numeral including the correct base. So a binary number would be written with a subscript 2, an octal number would be written with a subscript 8, and a hexadecimal number with a subscript 16. And, of course, when mixing bases, a decimal number can be written with a subscript 10 to avoid confusion. Example: $1111010100_2 = 1724_8 = 980_{10} = 3D4_{16}$

Christopher Wesling
San Francisco, CA

Yes, subscripts are the mathematical *way. But our use of that convention might seem to confuse because it is not a notation that can be programmed. That's why we choose to use the language notation, cryptic as it might be in some cases.*

—WF

Debugging Time

Great special section on debugging in the May issue. For years I have been a professional debugger and enjoyed reading about this often neglected subject. I especially liked "Debugging" (Will Fastie, May 1984, page 5)—as always, entertaining reading.

As the author of a new debugging tool just reaching the micro software market, I have had occasion to consider many of the points covered in the debugging section. I paid special attention to "Time on Your Hands" (Bob Smith and Tom Puckett, May 1984, page 146). Since this particular problem area seems to interest so many people, I included a short discussion of it in the Theory of Operations section of the manual for PC-TEST (my contribution to the art of debugging the PC), and I include it here for publication.

The Timer Bug

A note here on the widely discussed "timer bug" from which the original DOS debugger suffers. The problem lies in the architecture of the 8088 and can best be explained by single-stepping an INT instruction. The "timer" problem and the actions of the 8088 when single-stepping an INT instruction are one and the same: the number and the priority of the interrupt requests that the 8088 has pending.

The INT instruction causes the assertion of an interrupt request (just like the timer). If the TRAP FLAG is on during the execution of the INT instruction, it also causes assertion of an interrupt request for Single Step, which is of higher priority than the first one. Two sets of registers and flags are pushed onto the stack, one pointing at the instruction after the INT instruction (this entry has the TRAP FLAG on) and one pointing at the first instruction of the interrupt routine for that particular interrupt type (the instruction pointed to by that particular interrupt vector).

The result of this is that the highest priority interrupt routine (Single Step) is in control of the machine, and the next highest is on the stack ready for execution when the current routine executes IRET. One fix for this problem, published in a popular PC magazine, suggests checking the 8259 status register. This works fine on a machine which uses standard IBM equipment but can still fail with some vendors' implementations of clock cards and interrupt priorities. An alternative and more reliable fix (with the luxury of source code availability) is to check the stack contents for the location of the TRAP FLAG.

If the problem-causing sequence has occurred, the last entry on the stack will not have the TRAP FLAG on, and it is then up to the debugger to determine if it has just single-stepped an INT or IRET instruction or if other hardware requested the interrupt (if so, it must be serviced before the single-step via an immediate IRET). If the interrupt is from the execution of an INT instruction, the TRAP FLAG deeper on the stack must be turned off to prevent extraneous single-step interrupts later, on exit from the single-stepped interrupt routine (the original DOS debugger also suffers from this problem). *Copyright Armand J. Minnie. 1984*

Armand J. Minnie
San Jose, CA

The Hidden Path

The letter to the editor entitled "Where Were We?" (February 1984, page 22) contained a very interesting routine, "PWD." After assembling, linking, and creating a .COM file on my C: disk (default), I typed in PWD. Sure enough, the message that came back was C:/.

Next I created several directories /ALPHA/BETA/DELTA, and made DELTA the current directory. Then I typed in PWD and waited for something to happen. To my surprise the message this time was BAD COMMAND OR FILE NAME.

It seems that Bruce Kvam (the writer of the letter) neglected to tell us about the PATH command that we must use to get PWD to work. After going back to the root directory, I edited my AUTOEXEC.BAT file to add the line PATH C:/ and went back to DELTA. This time PWD worked like a charm, responding with the message C:/ALPHA-/BETA/DELTA.

I feel strongly that Mr. Kvam should have described the need to use the PATH command, for without it PWD is really useless. In addition, I feel even more strongly about the failure of your technical editors to check out that what you publish works, and in this specific case to correct Mr. Kvam's omission.

Everything considered, you publish an excellent magazine that I find more useful than your heftier competition.

George Shulha
Tampa, FL

Printing APL Characters

Your Letters section of the June 1984 issue of *PC Tech Journal* calls attention to the difficulty of getting a full APL character set for non-IBM printers ("Patch to AP8O.COM," page 21). For $100, SYMBIOTICS can furnish an extended character set APL EPROM with translation tables for the Epson MX-100 that will function with both IM and STSC (Scientific Time Share Corp.) implementations of APL. Interested persons may call or write SYMBIOTICS for details at 431 Mishler Road, Mogadore, OH 44260; 216-699-4978.

W.E. Claxton
SYMBIOTICS
Mogadore, OH

Thank you for your questions and comments. We appreciate all of them—complimentary and critical. Please address editorial correspondence to PC Tech Journal, *Suite 211, World Trade Center, Baltimore, MD 21202, or contact us through CompuServe, 74156, 2365, or The Source, STY682. Be sure to include your name and address.*

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Random Rumors and Gossip

It is expected that **AT&T** soon will announce its IBM PC-compatible desktop computer, which will probably be an upgraded version of the Olivetti system, using an 8-Mhz 8086 and 512K of RAM. An XT version should contain a 10-Mb Winchester and dual slim-line drives, and the basic system should contain serial and parallel ports, calendar/clock, disk controller, and seven expansion slots. In addition, it is expected to have better graphics than the IBM machine. AT&T is expected to sell the machine through Bell System stores and at least one chain of computer stores. Rumors continue that this fall **IBM** will announce a lap-sized, portable, battery-operated version of the PC that may contain a display that has 24 lines by 80 characters. **National Semiconductor** is said to be readying an IBM-PC compatible in both desktop and lap-sized portable versions, with special graphics capabilities. Rather than try to market the machine itself, the company is expected to enter into an OEM arrangement. **Compaq Computer Corp.** has indicated that it expects a decrease in earnings for the second quarter of 1984. **Mitsubishi,** which private-labels IBM compatibles for Sperry and Leading Edge Products, has indicated that it plans to begin selling PC compatibles in the U.S. under its own name.

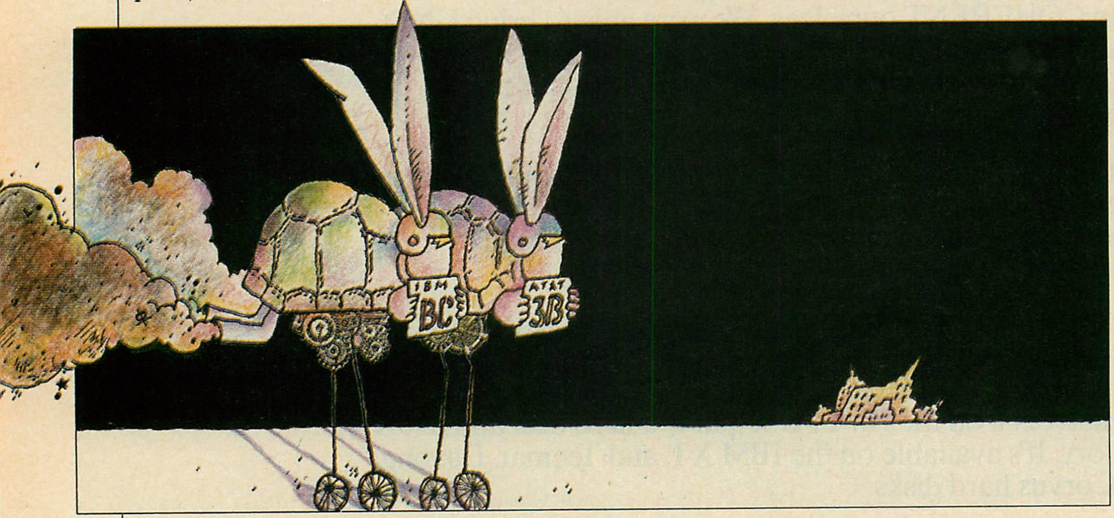

ILLUSTRATION • DAVID POVILAITIS

IBM "BC" Rumors

There are rumors that IBM will shortly announce three new "Business Computer" ("BC") systems based on the new Intel 80186 and 80286 microprocessors. The systems are expected to be sold through IBM's Value Added Resellers (VARs), and they should use either Microsoft's multi-user/multi-processing XENIX operating system or a new operating system that will be written by IBM.

The systems appear to be designed to compete with the new 3B series of microcomputers recently introduced by AT&T. The first system is expected to use the 80186 microprocessor and to have 256K of memory, a 10-Mb hard disk drive, and support for high-resolution graphics. It might run a new version of PC/DOS.

The second system is expected to use the 80286 8-Mhz microprocessor and to have a cache memory system, virtually unlimited hard disk capacity, 512K of memory, and the ability to handle up to 16 users. The operating system used on this system is expected to be an upgraded version of XENIX, with windowing capability and a PC/DOS emulator that will allow the execution of most PC software. The machine is expected to be used as a file server in a local area network for PCs, using Microsoft's MS-Net version of MS/PC-DOS.

It is anticipated that the third system will use a proprietary 32-bit microprocessor that was developed by IBM in Austin, Texas. Mainframe software environments, such as VM (Virtual Memory), supposedly will be supported. This system is expected to act as a cluster controller for SNA devices.

IBM's scientific instruments division may soon unveil a new version of the Microsoft XENIX operating system for its CS9000, 68000-based office system. This new operating system should provide enhanced graphics with features such as icons and windows.

CEEC Charges IBM Stifles Competition

The Commission of the European Economic Community is expected shortly to charge IBM with abusing its dominant market position in Europe and trying to stifle competition. The CEEC represents the 10-member European Common Market.

It is estimated that IBM currently controls about 40 percent of the European computer market in general and an even greater percentage of the market in West Germany and Italy. The Common Market computer companies complain that IBM has refused to provide them with information necessary to link peripheral equipment and software with new IBM products. Because equipment is introduced and orders taken many months before delivery, these companies must wait until they can actually get their hands on the equipment before they can begin their designs. As a result, they lose a year or more in getting their products to market. Then, as soon as they get their equipment on the market, IBM introduces new products.

The CEEC is expected to levy sanctions against IBM in the form of a fine or a re-

News, views, and gossip on the IBM and IBM-like marketplace

quirement that IBM disclose necessary information. IBM has been attempting for several months to negotiate a settlement with the CEEC, but has had no success. This problem is expected to alter IBM's selling tactics in Europe significantly.

IBM PC Shortage is Ended

IBM dealers report that the supply of IBM PCs and XTs has caught up with demand. Dealers say that the number of machines they can order is no longer being regulated by IBM, and most dealers have machines in stock. The result is an upsurge in discounts given on PCs, XTs, and their compatibles. Even the IBM PC portable, which IBM began shipping in April, is already being discounted by many dealers. The PC*jr*, whose sales have proved a bit disappointing, has been heavily discounted by dealers since it became available in February.

Another result of the increase in the supply of PCs and XTs is that some authorized IBM retailers, VARs, and Value Added Dealers (VADs) are dumping systems to unauthorized dealers and discounters. The authorized sellers invariably have to pay interest on systems that have been in their stock for over 30 days. In addition, they have to fulfill purchasing quotas with IBM. To avoid this situation, at the end of the month dealers will dump their inventory to unauthorized dealers at substantial discounts.

These unauthorized dealers are always low-budget retail or mail-order operations that provide little, if any, support and can therefore afford to discount the systems. IBM, unlike Apple, has chosen to ignore this "gray" market and thereby appears to be encouraging it.

dBASE III

After 22 months, Ashton-Tate has announced dBASE III for the 16-bit world. The product will be available initially for the IBM PC or XT with at least 256K and two floppies or a fixed disk. dBASE III removes many of the limitations of dBASE II. Files can now have up to 2 billion records, limited only by the individual computer systems. Each record can have 128 fields, and 10 files can be opened at once.

Although dBASE III has been redesigned from the ground up and written in C, many familiar dBASE II commands are still present. Features include the ability to establish relations between files, full-screen report generation, and mailing label capability; in addition, new memo fields can hold variable-length text of up to 4K bytes. Performance has been improved with notably faster sorting and indexing. A dBASE Assistant provides a command-assistance mode that can be turned off once the user is familiar with dBASE III operations. dBASE III is priced at $695, and the price of dBASE II has been reduced to $495.

The dBASE aftermarket is still alive and well. Fox and Geller announced the availability of Quickcode III, dUTIL III, and dGRAPH III. Other vendors are expected to follow with updated versions of their dBASE II enhancement programs.

3270-PC Popular

There is an increasing number of reports that the 3270 version of the PC is achieving a success in large corporations that use IBM mainframes; the reports also indicate that IBM has stepped up

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THE TECH JOURNAL NEWSLINE

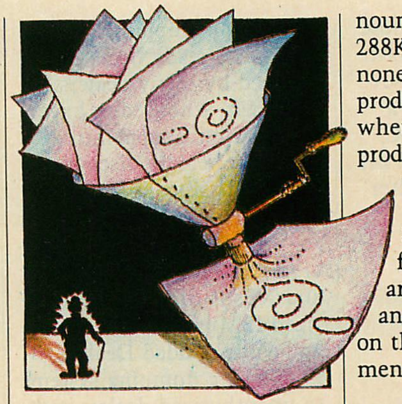
production significantly to meet the demand. Digital Research, Inc. has announced that it will make available its entire line of languages to run on the system, and there are rumors that DRI is also working on a new operating system for the 3270 that will allow CP/M, UNIX System V, and MS/DOS software to be run and that will also furnish local area networking and sophisticated graphics support.

The XT/370, however, which was introduced at the same time, appears to be lagging in popularity. Part of the problem seems to be late deliveries caused by production bottlenecks. Although the XT/370 was announced in late November 1983, IBM did not begin shipping systems until early May.

IBM Announces New Research Successes

At the IEEE-Intermag conference held in April, IBM researchers reported that they are working on a new type of magnetic recording head that will permit magnetic disk storage up to six times denser than current heads will allow. The head integrates thin film coils to write data on the disk and high-sensitivity, solid-state sensors to read the data. This work is still considered to be in a early research stage, and it will be some time before the technology will be ready for possible use in disk drives.

Researchers working at IBM's Essex Junction, Vermont, facility have an-



nounced development of a dynamic RAM chip with a capacity of 1 megabit. The chip operates on 5 volts and uses essentially the same technology as is used in the 64K RAM chip that is currently in production.

It is interesting to note that during the past two years IBM has also announced experimental 72K, 288K, and 512K RAM chips, none of which has gone into production. IBM has not said whether it actually plans to produce the 1-Mb chip. Further, it should be noted that at the International Solid States Circuits Conference held last February, Hitachi, Fujitsu, NEC, and NTT released details on their 1-megabyte experimental RAM chips.

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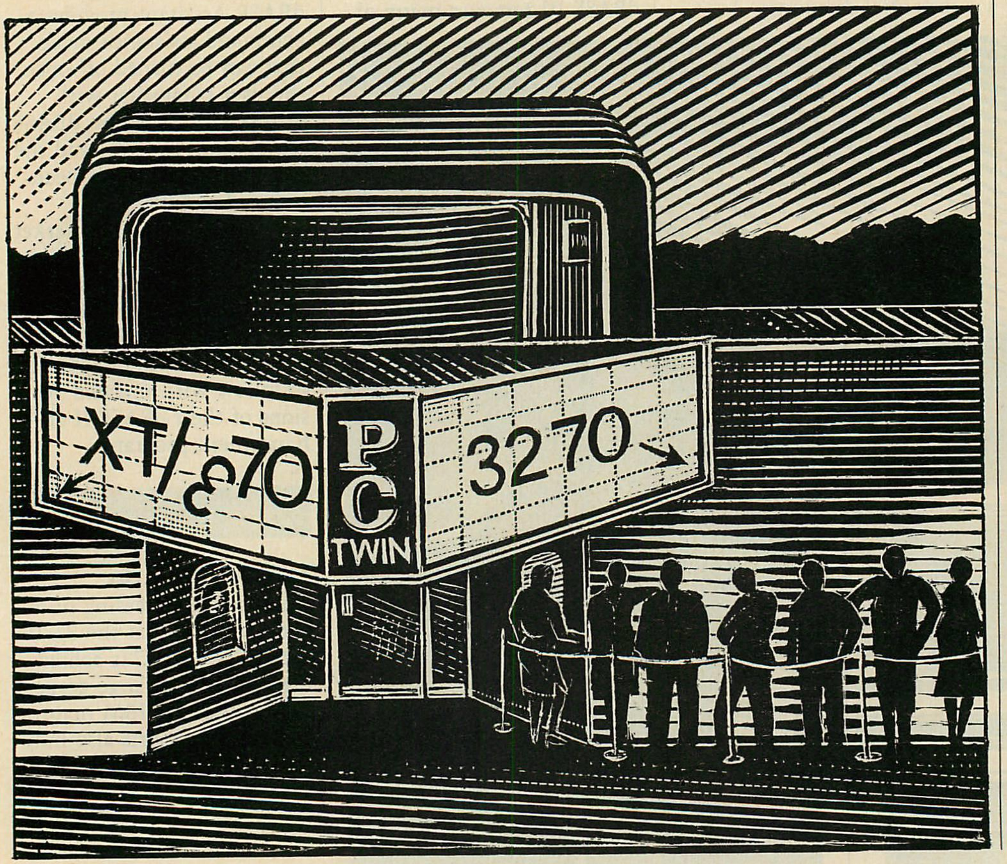
Random News Bits

IBM announced that its net income for the first quarter of 1984 rose 23 percent to a record $1.2 billion. Gross business was up 15.7 percent to $9.6 billion. PC business currently accounts for an estimated 13 percent of the company's revenues, or about $1.25 billion. **Lotus Development Corporation** reported a first-quarter net income of $7.5 million on $28.3 million sales—how's that for profit? Lotus is reported to have shipped almost 120,000 copies of Lotus 1-2-3 in the first quarter.

Quotation of the Month

John R. Opel, Chairman of IBM Corporation: "It [the PC*jr*] has not been as successful as I would like."



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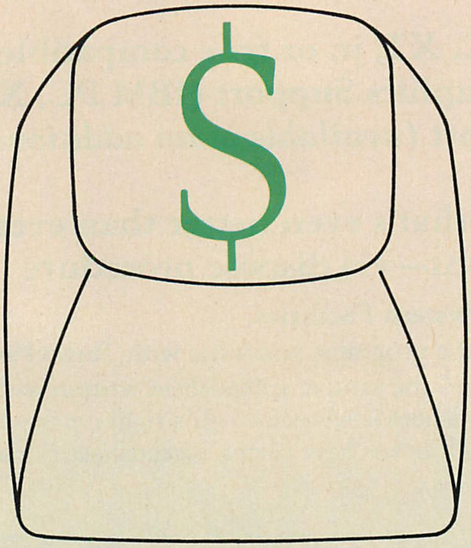
CONTROLLING INPUT USING INKEY$



A useful, adaptable routine for BASIC programs

NELSON FORD

An INKEY routine is one that controls keyboard input into a program by using the INKEY$ function instead of the INPUT or LINE INPUT commands. The sole reason for using this approach is that the INPUT command will accept and print any key that is pressed, which can sometimes cause problems. If the user accidentally enters "End" when he meant to enter "1," the cursor on the screen will obediently move to the end of the line.

When INKEY$ is used, the result of the key press is not automatically sent to the screen; thus, that result can be tested before it is

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printed. INKEY$ can be used not only to filter out keys that are destructive to the screen layout but also to check that the key falls within an acceptable range of keys, to see if a function key or other special key has been pressed, and to take special action if it is necessary. This function can also be used to read a key press, translate the key to another key defined on a look-up table, and send the translated value to the screen for display.

Running the Program

The program in listing 1 first presents a menu on the screen with a flashing cursor prompting the user to enter a number from the menu. If no number is entered, nothing happens. If "1" is pressed, a data entry form with fields labeled Name, Address, City, State, and Zip is displayed. A highlighted field appears next to the Name field. If the user enters a name in this field, the highlighted area moves to the next field for the address to be entered.

Errors in previous fields can be corrected by using the cursor direction keys. If a state or zip code is entered that the program does not recognize, the highlighted area will not move on until the entry has been corrected. Letters entered for the state display are displayed as upper-case, no matter how Caps Lock is toggled. Only the characters "0" through "9" are accepted as input in the Zip field.

Program Framework

Listing 1 is an example of a program that would be used to enter data in a data base. Lines 10-60 define variables for use by the program. FG and BG are used to control the foreground and background colors. The numbers in line 60 are the ASCII codes for the second character of the two-character code that is returned by INKEY$ when a special key is pressed. A special key is a function key, cursor key, shift tab key, or any key combination using the Ctrl

or Alt key. The codes for these keys are given in the BASIC manual at the end of Appendix G. The actual INKEY$ routine is in lines 120-620. The remainder of the program, starting at line 670, is a sample application designed to demonstrate the INKEY$ routine.

Walking Through the Code

In lines 700-750, a menu is printed on the screen. At line 760, the cursor is located at the point where the programmer wants the prompt to appear. The variable FL (Field Length) is set to 301, ACCEPT$ is defined as "123" (acceptable input), and control is turned over to the INKEY routine. Line 120 initializes the variables used in the INKEY routine. The variable INS.LENGTH keeps track of how many characters have been entered. CURSOR.POS keeps track of where the cursor is in the string of characters entered. This is necessary because the user can press the cursor keys to go back and edit the entry.

INKEY$ can be used not only to filter out keys that are destructive to the screen layout but also to check that the key falls within an acceptable range of keys, to see if a function key or other special key has been pressed, and to take special action if necessary.

In the next line, the variable CURSOR.START is set up to keep track of the location of the start of the field on the screen. Because input is limited to the current screen line, it is not necessary to keep track of the line number. Line 140 divides FL (which was set to 301) by 100 and truncates the decimals, leaving three (FIX(301/100)=3) and assigns this value to the variable name CHAR.ACCEPT.CODE, which will be used later to test the keys pressed. The next line redefines FL as the actual field length (301 - 3*100 = 1).

No prompt was specified, so line 170 is skipped. In line 180, the foreground and background colors are reversed. When the INKEY routine returns to control, the input is contained in the variable IN$. Line 160 initializes IN$ to a string of blank spaces. When the IN$ is printed (line 190) with the colors reversed, a highlighted area the length of FL appears. Line 210 causes the program to wait for a key to be pressed and assigns the key press to the variable N$. If the length of N$ is greater than one, the program knows a special key was pressed; lines 240 through 330 analyze and act upon the key press. This section of code is used in this program for editing the entry. If the programmer does not want this feature, he can omit this section.

For right now, we will assume that "1" was pressed on the menu, so N$ = 1. The length of N$ is 1, so the program is directed to line 350, which tests to see if the Esc key was pressed. If the variable CURSOR.POS is greater than the maximum number of characters specified in FL, the only input that can be accepted at this point—after the program has tested for cursor keys and the Esc key—is the Enter key or the Backspace key. In this example, the variable CURSOR.POS still has the value 1, which was assigned to it in line 120, and FL is also 1, so we can continue.

The CHAR.ACCEPT.CODE was calculated to be 3; therefore, line 390 says that N$ must be a character in the ACCEPT$ variable that was defined earlier as "123" by the main program. N$ is such a character, so the program now branches to line 500, which uses the MID$ function to put the key that was pressed into IN$ and which directs the program to line 550. (INSERT is toggled on and off in line 270. I'll look at that later.)

Skipping line 550 for right now, we see that N$ is printed, CURSOR.POS and INS.LENGTH are incremented, and the program branches back to line 190 to pick up another key press. This time the user presses Enter. The program flows to line 420 and gets redirected to line 600, which reprints the entry with the colors set back to normal. At this point, if the entry is shorter than the maximum field length, the trailing blanks are chopped off, unless line 610 has been removed.

Now control is passed back to the main program, and no further input testing is needed. IN$ must be a "1," "2," or "3." Since "1" was entered in this instance, the program branches to line 1000.

One More Time

Line 1090 positions the cursor, assigns a maximum field length of 25 with no character acceptance code (any input is valid), and defines the prompt as NAM$(I). When the program is first started, the variable NAM$(I) (where I=1) is a null string, so there is no prompt. Let's pretend that we loaded an entry from a disk file, and NAM$(I) contains a name that is now assigned to PROMPT$. Having set up the variables, the program returns to the INKEY routine.

If the first key pressed is an "A," the program flows to line 380 (CHAR.ACCEPT.CODE=0) and then to 500 and on to 550. When a prompt appears, as it does in this example, the program must try to determine if the user wants to edit the prompted entry or type in a new one. Keep in mind that if a cursor key had been pressed to move into the field in order to make a correction, the cursor positioning would have bypassed line 550. This line of code is only reached when a

character is being entered. Therefore, if the user is still at the beginning of the field and is entering a character, he is probably entering a new name rather than editing an old one. So this line blanks out the field in addition to the variable IN$.

Processing a Cursor Key

If the user entered the characters "Jogson" and wanted to go back and change the "g" to an "h," he would press the left cursor key, which causes N$ to be a two-character code with the second character having an ASCII value of 75. At line 250, if the variable CURSOR.POS is greater than 1, it is decremented and the program goes back for another key press. The user keeps pressing the left cursor until it moves back to the "g"; he then presses "h." The program flows to line 500 and the MID$ function replaces the "g" with the "h."

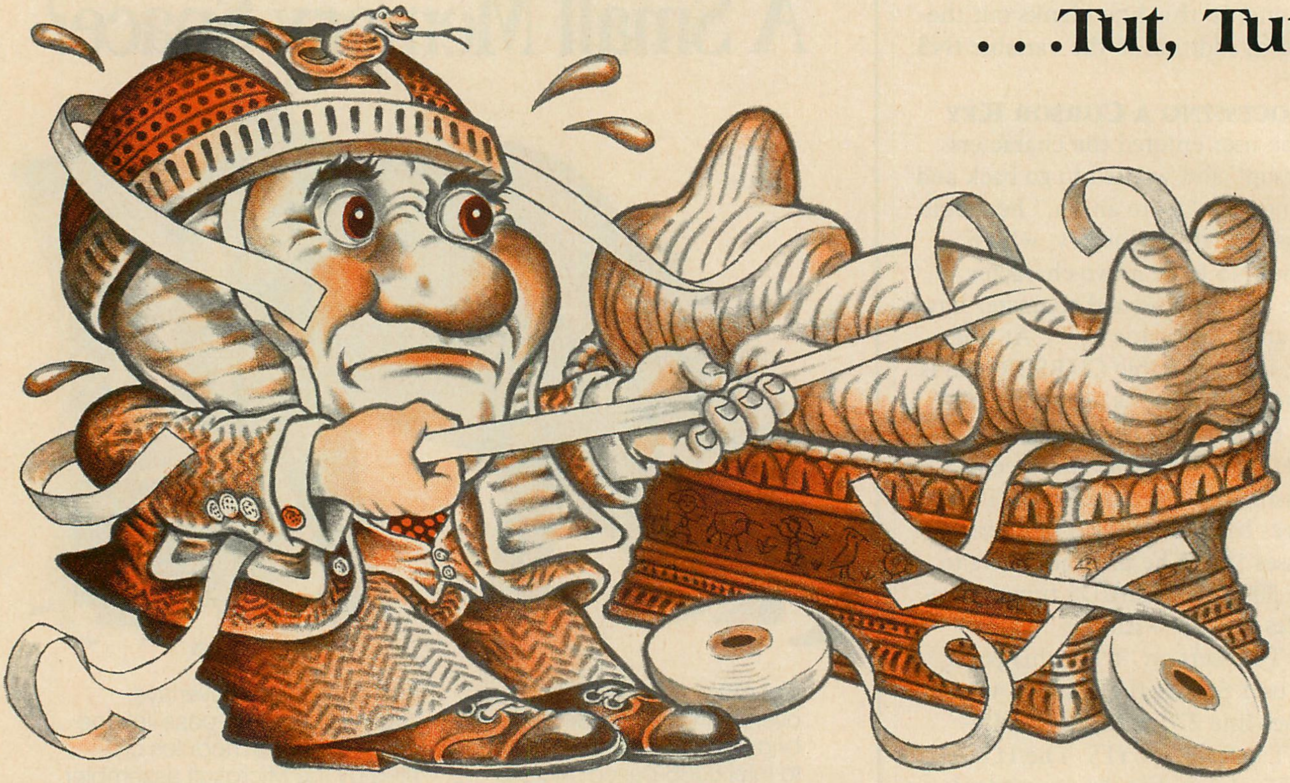
To insert an "n" at this point, the user presses the Ins key, which causes line 270 to toggle the INSERT variable to YES. The LOCATE,,,4,7 makes the cursor look like it does in BASIC when the user is in the insert mode. When the "n" key is pressed and the program gets to line 500, the MID$ function is not used. Line 510 checks to make sure that the user is not trying to insert characters when the input is already equal to the maximum field length. Line 520 cuts open IN$ and inserts the character.

Other Special Keys

Line 260 handles the Del key by cutting the character being deleted from IN$ and adding a blank space at the end. Line 280 reacts to the Home key being pressed by changing CURSOR.POS to 1. Line 290 deletes the end of the entry, starting at the current CURSOR.POS. Line 300 increments CURSOR.POS (limited to the field length) when the right cursor key is pressed. Finally, line 310 moves the cursor to the end of the entry.

Considering Tape For Backup Storage?

. . .Tut, Tut.



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If the key pressed has not been handled by one of these lines, it must be analyzed by the main program. Therefore, MOVE.IT is set to

I have seen some otherwise very good programs that make it possible for the user to inadvertently destroy the screen layout or that make it difficult for the user to go back and correct entries.

true (the value of the key pressed was assigned to the variable KY in line 240), and the routine returns to the main program.

For example, pressing the up cursor key will cause MOVE.IT to be set to YES, and a return will be done. In line 1140, the program moves back to the preceding field so the user can change the entry. In line 1100, the program assumes that the user wants the prior entry, since there are no prior fields. By testing the value of KY, the user could add different instructions for each possible special key, such as PgUp, PgDn, F1, Cursor Down, etc.

JUST ANOTHER INKEY ROUTINE?

INKEY routines are as common as dust, but I feel that this one has some good features not commonly found in such routines. Still, I can almost guarantee that most programmers will want to modify it for their own use. In fact, I frequently modify it for different applications.

As a software reviewer, I have seen otherwise good programs that permit the user to inadvertently destroy the screen layout or that make it difficult for him to go back and correct entries. This routine should give programmers some ideas for building both control and flexibility into programs.

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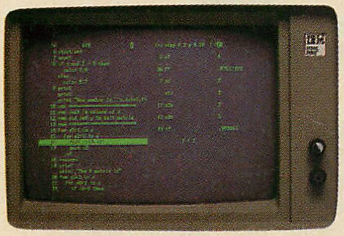

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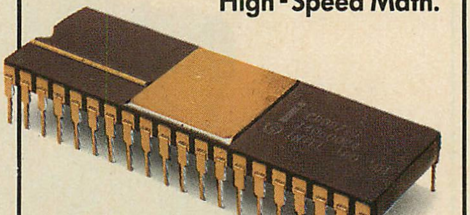

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Listing 1 INKEY.BAS

```
10 DEFINT A-Z: SCREEN 0,0,0,0: WIDTH 80
15 FG=7: BF=0: COLOR FG,BG: CLS
20 DEF SEG:  POKE 106,0
30 YES = NOT NO:    NO = NOT YES
40 ESC = 27:  ESC$ = CHR$(ESC)
45 ENTR$ = CHR$(13)
50 BACKSPACE$ = CHR$(8)
60 LF.CURSOR=75:  RT.CURSOR=77
65 END.KEY=79:  INS.KEY=82:  DEL.KEY=83
66 HOME=71:  CTRL.END=117
70 GOTO 700
90 '
91 ''''inkey routine''''
92 '
100 'FL is the field length, passed
105 'to this routine by the main program.
110 '
120 INS.LENGTH = 0:  CURSOR.POS = 1
125 SOUND 80, .03: MOVE.IT = NO: KY = 0
130 CURSOR.START = POS(0)
140 CHAR.ACCEPT.CODE = FIX( FL / 100 )
150 FL = FL - CHAR.ACCEPT.CODE*100
160 IN$ = SPACE$(FL)
170 IF PROMPT$<>""
 THEN IN$=LEFT$(PROMPT$+SPACE$(FL),FL)
175 INS.LENGTH=LEN(PROMPT$): PROMPT$=""
180 COLOR BG,FG
190 LOCATE, CURSOR.START, 1:   PRINT IN$;
200 LOCATE, CURSOR.START + CURSOR.POS - 1
210 N$ = INKEY$:   IF N$ = "" THEN 210
220 IF LEN(N$) = 1 THEN 350
230 ' Lines 240 thru 330 check for special keys.
235 'You can omit this section if you do not need
236 'this function.
240 KY = ASC( RIGHT$(N$,1) )
245 ' check for edit keys:
250 IF KY=LF.CURSOR THEN IF CURSOR.POS>1
    THEN CURSOR.POS=CURSOR.POS-1:GOTO 200 ELSE 320
260 IF KY=DEL.KEY
    THEN IN$=LEFT$(IN$, CURSOR.POS-1) + RIGHT$(IN$,FL-CURSOR.POS)+" ":
         INS.LENGTH = INS.LENGTH - 1:  GOTO 190
270 IF KY=INS.KEY THEN IF INSERT=NO THEN INSERT=YES
275 LOCATE,,,4,7: GOTO 190 ELSE INSERT=NO: LOCATE,,,7: GOTO210
280 IF KY = HOME THEN CURSOR.POS = 1: GOTO 200
290 IF KY = CTRL.END THEN IN$ = LEFT$(IN$,CURSOR.POS-1) +
    SPACE$(FL - CURSOR.POS + 1):   INS.LENGTH = CURSOR.POS - 1:  GOTO 190
300 IF KY= RT.CURSOR THEN CURSOR.POS = CURSOR.POS -
    (CURSOR.POS < INS.LENGTH): GOTO 200
310 IF KY = END.KEY THEN CURSOR.POS = INS.LENGTH + 1:  GOTO 200
320 MOVE.IT = YES
330   GOTO 600  'not an edit key, but is a special key:  end input.
340 '
350 IF N$ = ESC$ THEN KY = ESC:  IN$=N$:  GOTO 320
360 IF CURSOR.POS = 1 THEN IF N$ = "-" OR N$ = "+" THEN IN$ = N$:
    COLOR FG,BG:LOCATE,,0: RETURN
370 IF CURSOR.POS > FL THEN 420
380 IF CHAR.ACCEPT.CODE = 0 AND N$ >= " " AND N$ <= "z" THEN 500
390 IF CHAR.ACCEPT.CODE = 1 AND N$ >= "0" AND N$ <= "9" THEN 500
400 IF CHAR.ACCEPT.CODE = 2 THEN IF N$ >= " " AND N$ <= "a" THEN 500
    ELSE IF N$ >= "a" AND N$ <= "z" THEN N$ = CHR$(ASC(N$)-32):
    GOTO 500
410 'IF CHAR.ACCEPT.CODE=3 THEN IF MID$(ACCEPT$,CURSOR.POS,1) = ? THEN ..
420 IF N$ = ENTR$ THEN 600
430 IF N$ <> BACKSPACE$ OR CURSOR.POS = 1 THEN 210
440 '
450 IN$ = LEFT$(IN$, CURSOR.POS-2) +RIGHT$(IN$, FL -CURSOR.POS+1)+" "
460 INS.LENGTH = INS.LENGTH -1
470 CURSOR.POS = CURSOR.POS -1
480   GOTO 190
490 '
500 IF NOT INSERT THEN MID$(IN$, CURSOR.POS, 1) = N$:  GOTO 550
510 IF INS.LENGTH >= FL   THEN 210
520 IN$= LEFT$(LEFT$(IN$,CURSOR.POS-1)+N$+RIGHT$(IN$,FL-CURSOR.POS+1),FL)
530 CURSOR.POS = CURSOR.POS + 1:    INS.LENGTH = INS.LENGTH + 1
540   GOTO 190
550 IF CURSOR.POS = 1 THEN IN$ = N$ + SPACE$(FL - 1):  PRINT IN$;:
    LOCATE, CURSOR.START:    INS.LENGTH = 1
560 PRINT N$;
570 CURSOR.POS = CURSOR.POS + 1
580 IF CURSOR.POS > INS.LENGTH THEN INS.LENGTH = CURSOR.POS - 1
590 IF FL > 1 THEN 190
600 COLOR FG,BG:  LOCATE, CURSOR.START, 0, 7:   PRINT IN$;
610 IN$ = LEFT$(IN$, INS.LENGTH):  INSERT = NO
620   RETURN
670 '
680 '                     main menu:
690 '
700 CLS
710 LOCATE  4,33:  PRINT "   MAIN MENU "
720 LOCATE 10,33:  PRINT "1  Enter Data"
730 LOCATE 11,33:  PRINT "2  Print Reports"
740 LOCATE 12,33:  PRINT "3  Save Data"
750 LOCATE 14,33:  PRINT "    SELECT  "
760 LOCATE 14,33:  FL = 101:  GOSUB 100
770 IF IN$ < "1" OR IN$ > "3" THEN 760
780 ON VAL(IN$) GOTO 1000, 2000, 3000
990 '
1000 'enter data:
1010 '
1020 CLS: LOCATE 4,35:  PRINT "DATA ENTRY":  I=1
1030 LOCATE 10,20:  PRINT "NAME:       "  NAM$(I)
1040 LOCATE 12,20:  PRINT "ADDRESS:  "  ADDR$(I)
1050 LOCATE 14,20:  PRINT "CITY:      "  CITY$(I)
1060 LOCATE 16,20:  PRINT "STATE:      "  STATE$(I)
1070 LOCATE 16,40:  PRINT "ZIP:   " ZIP$(I)
1079 '
1080 'name:
1090 LOCATE 10,30:  FL = 25:  PROMPT$ = NAM$(I):  GOSUB 100
1095 IF IN$ = ESC$ THEN 700
1100 IF MOVE.IT THEN IF I > 1 THEN I = I - 1:  GOTO 1030
1110 NAM$(I) = IN$
1120 'addr:
1130 LOCATE 12,30:  FL = 20:  PROMPT$ = ADDR$(I):  GOSUB 100
1140 IF MOVE.IT THEN 1090
1150 ADDR$(I) = IN$
1160 'city:
1170 LOCATE 14,30:  FL = 15:  PROMPT$ = CITY$(I):  GOSUB 100
1180 IF MOVE.IT THEN 1130
1190 CITY$(I) = IN$
1200 'state:
1210 LOCATE 16,30:  FL = 202:  PROMPT$ = STATE$(I):  GOSUB 100
1220 IF MOVE.IT THEN 1170
1230 STATES$="OK TX AL GA FL AZ SC MI"
1240 LOCATE 18,30
1250 IF INSTR(STATES$, IN$) = 0 THEN  PRINT "INVALID STATE":  GOTO 1210
     ELSE PRINT SPACE$(13)
1260 STATE$(I) = IN$
1270 'zip
1280 LOCATE 16,47:  FL = 105:  PROMPT$ = ZIP$(I):  GOSUB 100
1290 IF MOVE.IT THEN 1210
1300 LOCATE 18,46
1310 IF VAL(IN$)<30000 OR VAL(IN$)>89999! THEN PRINT"INVALID ZIP":
     GOTO 1280: ELSE PRINT SPACE$(11)
1320 ZIP$(I) = IN$
1330 'loop:
1340 I = I + 1
1350 GOTO 1030
2000 '
2010 GOTO 700
3000 '
3010 GOTO 700
```

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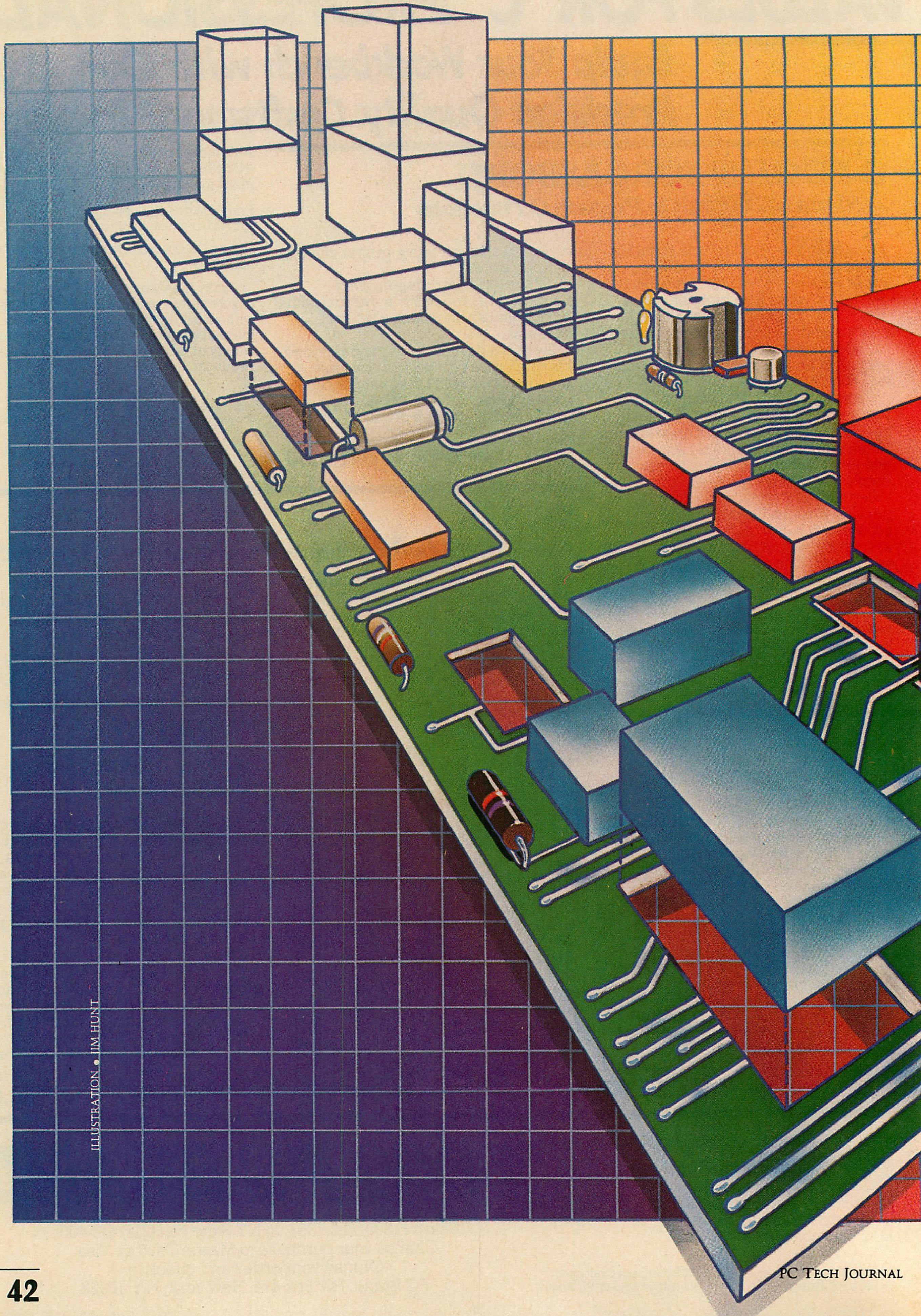
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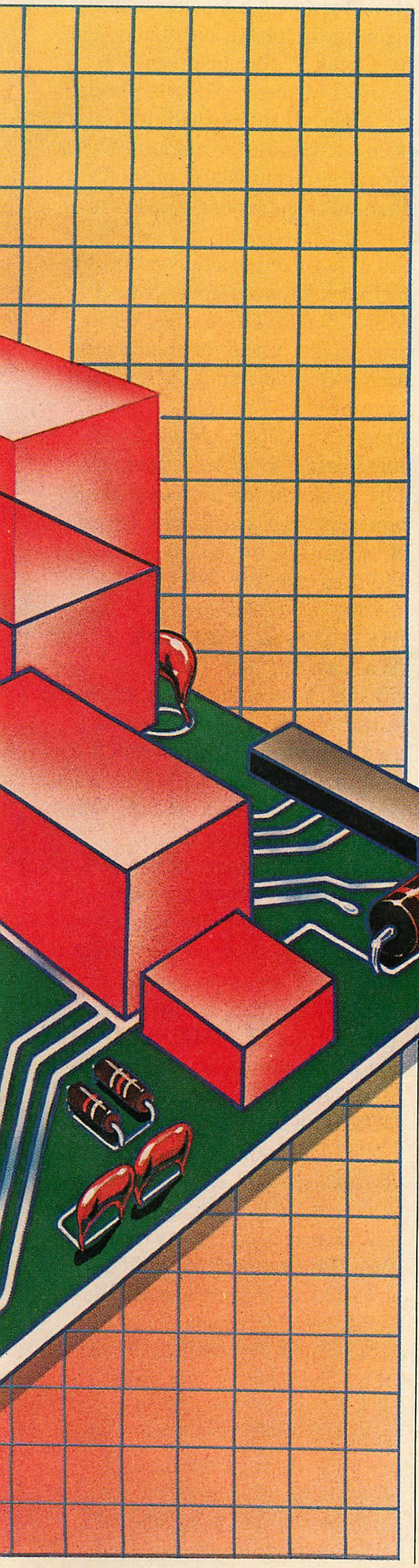

MANAGING MEMORY

A guided tour of DOS 2.0 memory management

WILLIAM J. REDMOND

One of the major advantages of the PC's 16-bit 8088 microprocessor is that it can address a megabyte of internal memory. This capability has allowed the development of word processing, spreadsheet, graphics, and data base programs (among others) with features that only a few years ago were limited to large mainframe computers. As new releases of PC-DOS have become more and more sophisticated, it has become necessary and desirable to increase the amount of memory available to the user.

For me, this was no problem. I purchased an IBM PC back in the days of DOS 1.0. It contained 64K of user memory, which was, of course, not enough, since I wanted to use the Macro Assembler (requiring 96K). I therefore bought a multifunction expansion board, allowing me to increase the memory on my system from 64K to 320K.

With that expansion board, however, my system took 52 seconds—it seemed like a lifetime—to go through its initialization routines from a power-up. I began to research a solution to my problem.

FUNDAMENTALS

Three categories of memory are inside the PC. The first type is ROM (or read-only memory), which contains the BIOS (BASIC I/O System) routines, system-initialization routines, and the cassette BASIC interpreter. The other two categories of memory—planar memory and I/O channel memory—are contained in RAM (random-access memory) and are intended for use by the operating system of the PC and by the user. *Planar* comes from the Latin word *planus*, which means level or flat. The word is used by computer technicians to refer to the main system board in the IBM PC. (This board is also commonly referred to as the mother board.)

The original PC allows for four rows, or banks, of RAM. Each bank contains 16K bytes with a parity bit. With the four banks filled, therefore, the original PC has a planar memory of 64K bytes. The newer board for the IBM PC utilizes the same four rows of chips, but the 256K memory chips are used in place of the 16K chips, allowing a maximum obtainable memory on the planar board of 256K bytes.

In either case, once the planar board is fully populated (that is, the

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maximum memory is installed on the board), if more RAM is desired, it is necessary to use an input/output expansion slot and install one of the many available memory expansion cards. The memory contained on these expansion boards is called *I/O channel memory*.

For purposes of clarity, the following discussion of switch settings will refer to the old-style planar board with 16K RAM chips. On the planar board are two switches (SW1 and SW2) that are used to designate the amount of planar and I/O channel memory present in any particular PC configuration. The values of these switches are used by the initialization routines in ROM to determine how much user memory (RAM) exists in the system. (See the Options section of the *Guide to Operations* to set these switches.)

Two toggle switches on SW1 indicate how much planar memory exists in increments of 16K. These two toggles may contain a binary value of 0 through 3, indicating 16K, 32K, 48K, or 64K.

SW2, on the other hand, uses four toggle switches (binary values 0 through 15) to designate how much I/O channel memory exists on the PC in increments of 32K.

Each 16K-byte block of memory is written with a data pattern, then read back and verified. Five data patterns (11111111, 01010101, 10101010, 0000001, and 00000000) are processed for every byte of memory. Given the amount of code that is executed to perform these tests, it takes about 2 seconds to initialize 16K bytes. A 64K-byte system will use about 8 seconds to initialize and verify all of the memory on the planar board.

While checking for data mismatch during this process, the memory test routines also check to see if parity errors have occurred. Each byte of memory contains 8 bits and a parity bit. The memory-write logic of the PC always records an odd number of "on" bits for each byte that is stored. If the number of "on" bits is even, the parity bit is set *on* to make the number of "on" bits odd for this byte. When data are read from memory, the memory-read logic checks to make sure that there is an odd number of "on" bits in each byte. If this is not true, a parity error is indicated.

Port 62H is the port address of SW2, which is used to indicate how much I/O channel memory exists. Bits 7 and 8 of this port are used by the planar board and memory expansion boards to indicate a parity error. Bit 7 is used for the parity check indicator for the I/O channel, and bit 8 is used for that indicator for the planar board.

Once the planar memory has been verified, the initialization routines check to see if the planar board is fully populated. If so, the input/output channel memory is then tested in the same fashion as is the planar board memory.

Once the planar memory has been verified, the initialization routines check to see if the planar board is fully populated. If so, the I/O channel memory is then tested in the same way the planar board memory was tested.

If a parity error or data mismatch occurs during the verification process, the monitor is reset to 40x25 video mode and an error message and memory address are displayed, along with one long and one short system beep. (Note: If the first 16K of planar memory fails initialization, no message is generated, and the processor simply halts.)

It is also useful to know that if a parity error occurs after system initialization, the monitor will display "Parity Check 1" for a parity error on the planar board and "Parity Check 2" for one on an I/O channel memory expansion board.

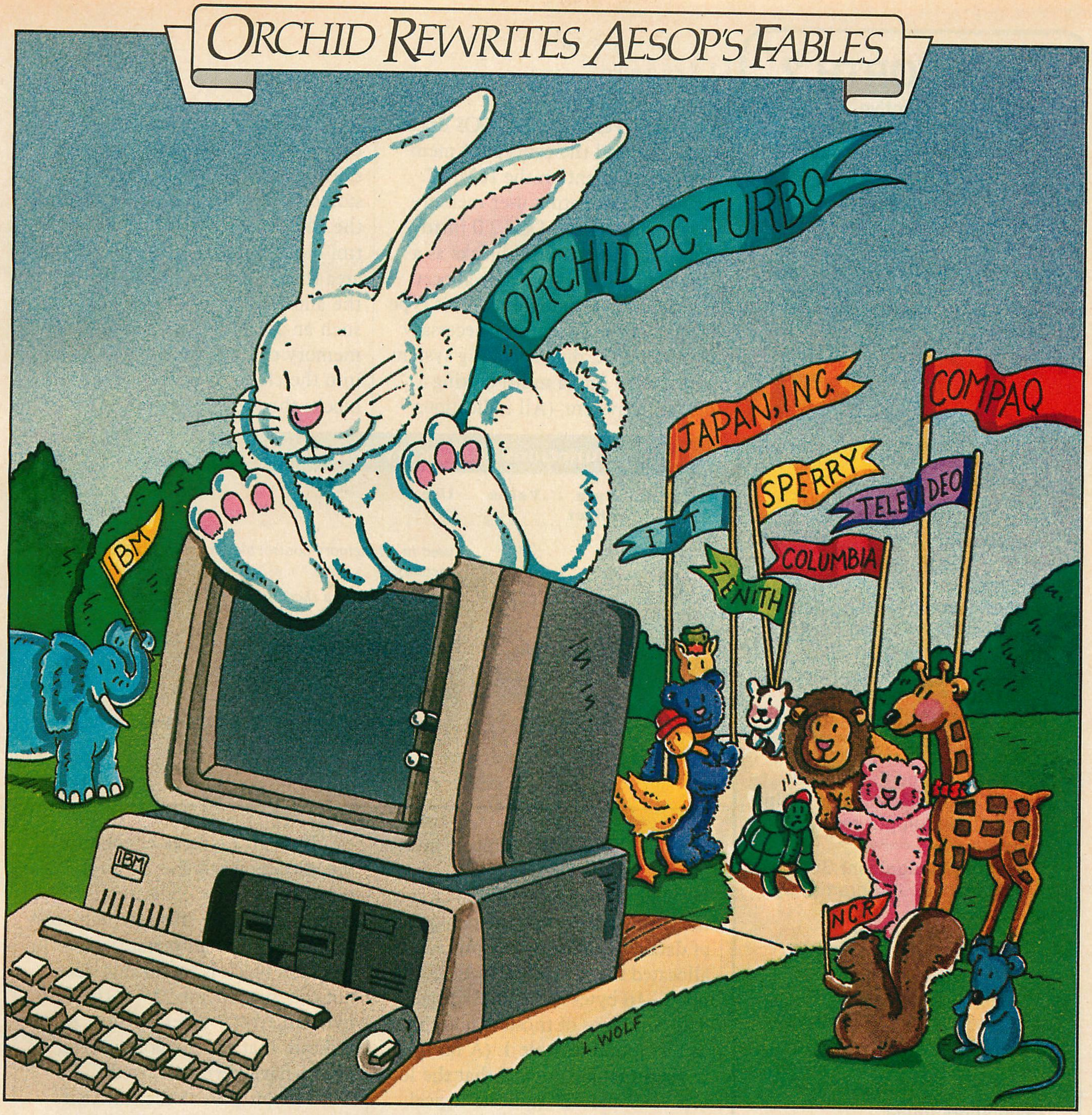
Once all this initialization has been successful, the amount of user memory (planar board, plus I/O channel if the planar board is fully populated) is stored in a variable located in a fixed location at 40:13 in memory. This variable is called MEMORY_SIZE (see page A-2 in the original *Technical Reference* and page A-3 in version 2-2). The total amount of I/O memory is then stored in the IO_RAM_SIZE variable, located at 40:15 in memory. The values stored in the variables represent the number of kilobytes of memory; a value of hexadecimal 140 thus indicates 320 bytes.

METHODS OF MEMORY MANAGEMENT

During DOS initialization, the value in the MEMORY_SIZE variable is used to inform DOS how much total memory is present. This is important because DOS is responsible for memory management.

Memory management refers to the process of allocating memory areas for use by programs and freeing those same memory areas when their use is no longer required. This includes assigning space for the COMMAND processor and all programs executed by COMMAND or any other program.

DOS 1.0 and 1.1. Versions 1.0 and 1.1 of DOS used a simplistic memory management scheme that was sufficient for the single-user, single-task systems that these versions were. The value of MEMORY_SIZE at 40:13 was captured locally in COMMAND's permanently resident portion, located just above DOS. The offset of this variable in DOS 1.1's COMMAND code segment is CS:452. Whenever a memory area was required for DOS 1.1, all available user memory was allocated by the user program itself; DOS was not directly involved.



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MEMORY

DOS 2.0. Version 2.0 of DOS drastically changed the concept of memory management on the IBM PC. Rather than treating user memory as one giant entry, DOS 2.0 introduced memory control blocks as a means of allocating and de-allocating memory for programs. This type of memory use control is necessary if the IBM PC disk operating system is to evolve into a multi-tasking operating system. (All indications are that DOS 3.0 will support multitasking on the PC.)

The memory control block is made up of 16 bytes (one paragraph) of data that immediately precede an allocated memory area. In DOS 2.0, not all 16 bytes are actually used. The functions of those that are used can be found in table 1. (A bit of trivia: in table 1, notice that the letters "M" and "Z" indicate logical ends of a chain of memory links. Note also that the first two letters of an EXE file that has been linked are "MZ." It seems more than just a little coincidental that the man who is most responsible for DOS 2.0 is named Mark Zbikowski.)

Table 1: Functions of Memory Control Block Bytes

Type	Byte offset	Value	Use
byte	*0*	*"M"*	*used in all memory control blocks except the last one in memory*
		"Z"	*is used to indicate that this is the last memory control block*
word	*1-2*	*0*	*indicates an available area*
		non-zero	*indicates an in-use area (points back to the program segment prefix)*
word	*3-4*		*indicates size of this area (in paragraphs) and is used for linking through memory areas*

Added Functions. Three new functions were added to DOS 2.0 to deal with these memory control blocks and to allocate and de-allocate memory for programs:

48 Allocate memory
49 Free allocated memory
4A Modify allocated memory blocks

The first function links through all memory control blocks starting at the memory address stored in DB:[10C] (which contains the address of the first memory control block) until it finds an available area that is large enough to satisfy the allocation request. Once it finds such an area, it builds an "in-use" memory control block and links it into the chain of memory control blocks through memory.

If no area is large enough for the allocation request, an error 8 is returned in AL to indicate insufficient memory. If, during the process of linking through memory control blocks, a block is found that does not contain "M" or "Z" as the first byte, an error 7 is returned in AL to indicate that the memory control blocks have been destroyed.

The purpose of the function that frees allocated memory is to mark a previously in-use memory control block to indicate that the memory area that follows is now available. This is done by storing zeros in the word at offset 1 in the memory control block.

The third new function, which modifies allocated memory blocks, changes the size of an in-use memory area (if possible). This may involve "growing" or "shrinking" the existing in-use area. (In the initial release of DOS 2.0, it appears that this DOS function will only "shrink" a memory area.)

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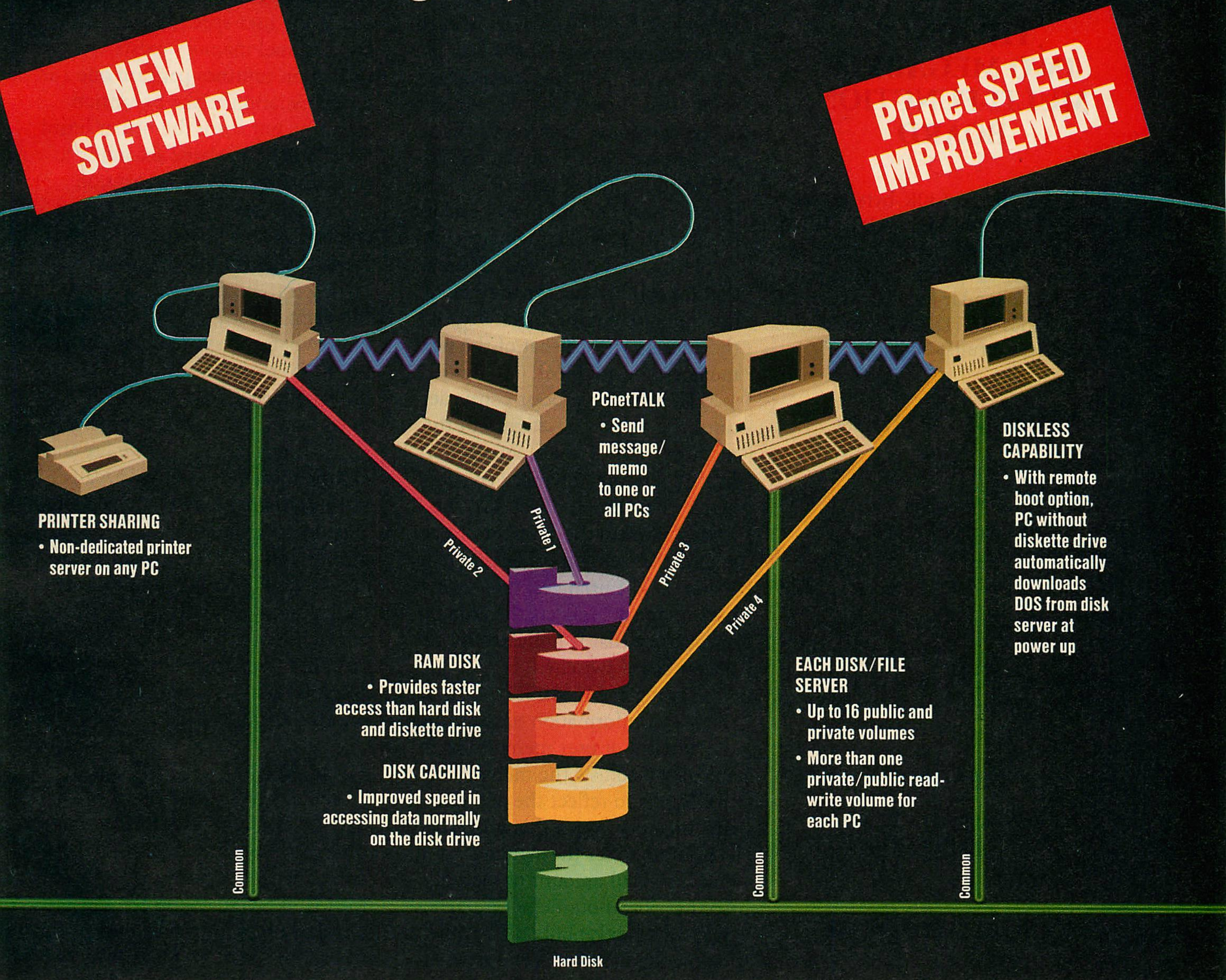

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MEMORY LINKS

Linking through the memory control blocks is relatively easy. Start with the address of the first memory control block, which depends on the version of DOS being run, whether a fixed disk is installed, and whether a PC*jr* is being used. In DOS 2.0, the pointer is located at address DB:10C; for DOS 2.1 it is found at DB:178. Add 8OH to each of these addresses if a hard disk is installed, and add 70H if a PC*jr* is being used. The final address points to the paragraph in memory that contains a memory control block. If the word located at byte offset 3 in this memory control block is added to the address of the memory control block, and if 1 is then added to that (to compensate for the size of the memory control block itself), the address will be that of the next memory control block (see figure 1).

This adding process continues until the byte at offset zero in the memory control block equals a "Z." In this "ending" memory control block, the word at offset 3 in the block indicates the number of paragraphs that remain in user memory. When DOS initializes, this "end of user memory" reflects the amount of memory that is indicated by the planar board switches.

Listing 1, MEMINIT.ASM, uses the above information to determine the amount of user memory available, then adjusts the memory control blocks to reflect the addition of this memory. With this program, it is possible to set the switches to indicate a small amount of memory (so that power-on memory diagnostics run quickly) but still be able to use all the user memory installed on the PC. Using MEMINIT, my system, with 320K user memory, powers up in 15 seconds (including the execution of MEMINIT).

The switches on the planar board are set up to indicate that 80K of user memory exists (even though there is actually 320K). This includes 48K on the planar board and 32K on the I/O channel. If the system has any I/O channel memory and parity is not disabled, a parity check is generated by the board when the system is powered up. This causes the memory test routines to sense a parity error during initialization of the planar board, and the system will halt with no error messages generated.

If the user specifies that some I/O channel memory exists, the initialization routines perform one 16K write operation to the expansion memory, but since the planar board is not fully populated according to the switches, the I/O expansion memory is never tested later. This one-time write operation effectively resets the parity check indicator, allowing initialization of the 48K on the planar board to finish normally. Now when the system powers up, the ROM routines recognize 48K of user memory (enough for DOS 2.0 to be loaded without any problem).

If it is necessary that more than 48K be recognized (either because some program contains its own bootable operating system or because device drivers are loaded prior to the completion of DOS initialization), the required minimum amount may be specified on the planar board switches. Remember that each 16K specified adds another 2 seconds to the initialization time.

HOW MEMINIT WORKS

Once DOS is initialized, MEMINIT may be executed to configure the user memory correctly on the system. The first function of MEMINIT is to determine the physical amount of user memory installed on the PC. This is accomplished by starting at the end of memory (as indicated by the planar board switches) and writing the segment number into that memory word. That word is then read back. If it contains the same data that were written, the program assumes that the memory exists and it, therefore, continues to run.

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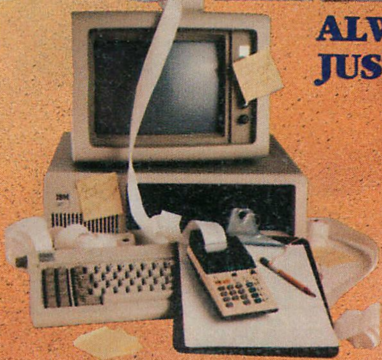

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**Available in July, 1984.

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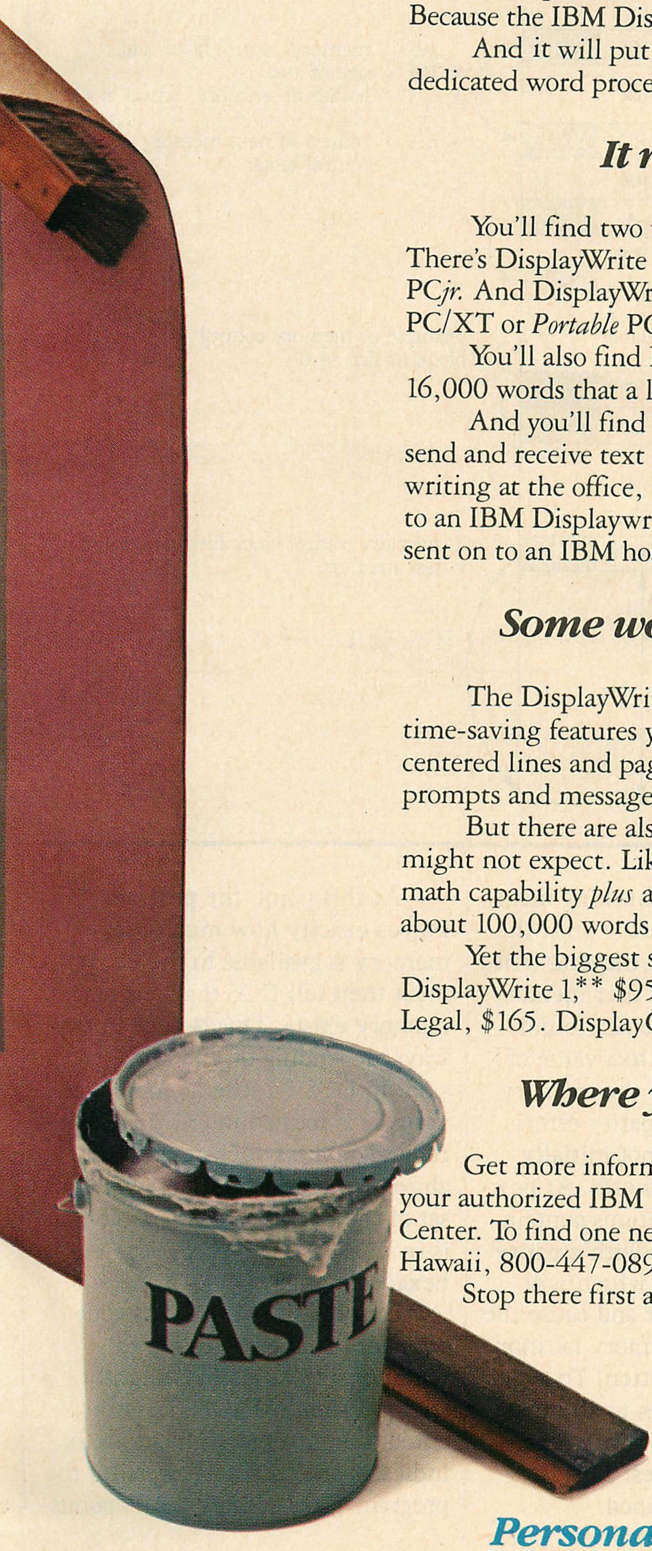

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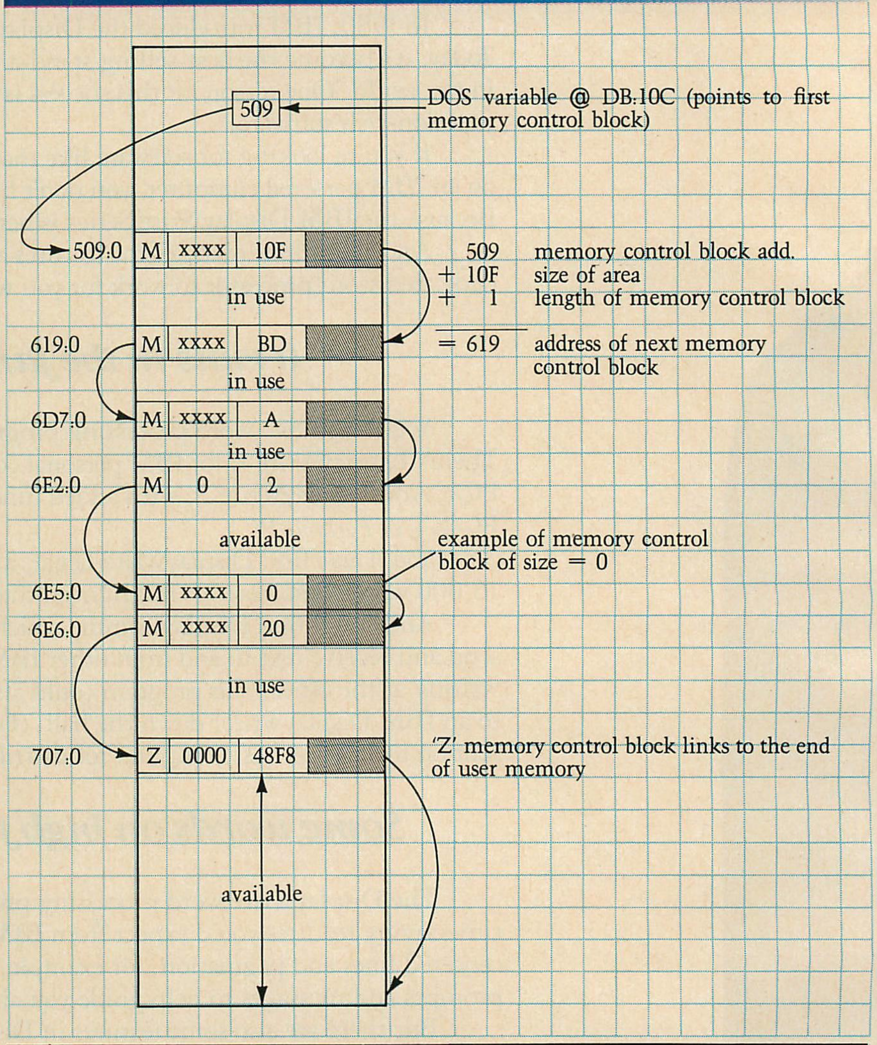
CIRCLE NO. 152 ON READER SERVICE CARD

Figure 1: DOS 2.0 Memory Control Block Chain



This loop keeps checking memory at each 16K boundary until the data read do not equal the data written or until the top of user memory (640K) is reached. The newfound memory is initialized to a value of hexadecimal 0. When the memory is read back, no false parity errors occur since BIOS did not initially touch these memory words. At power-up all memory locations contain a binary value of zero with a parity bit also equal to zero, which will generate a parity error and cause the system to halt if a memory location is read before it is written. To avoid this, MEMINIT writes to all new memory but does not verify it as BIOS initialization does. This is where the speed is gained.

At this point, the program knows exactly how much user memory is available to the PC. It must then tell DOS that this new memory exists. This is done in two ways, depending on the DOS version. In DOS 1.1, the memory size variable is located in COMMAND'S code segment, which resides just above DOS in low memory. The offset of the memory size variable that is in COMMAND's code segment is hexadecimal 452.

Locating COMMAND's code segment (in order to fix up this memory size variable) is slightly tricky. When MEMINIT is executed, the program segment prefix indicates a terminate address for the program. This address, CS:IP, points

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to the resident portion of COMMAND. By storing the CS portion of this address the program can locate and fix up the memory size variable that is stored there.

DOS 2.0, however, does not simply store the memory size in one of COMMAND's variables. Instead, memory links (like those described in this article) are constructed through memory. The last memory link constructed is an available link and defines the number of paragraphs of user memory existing beyond its own memory address. To modify this value (so that the additional user memory will be recognized and used by DOS) the program must chain through the memory links until the last link is reached. This is done in the subroutine called UPDATE_MEMORY_CONTROL_WORDS.

This routine starts at the memory control words immediately preceding the program segment prefix. It links through the memory control blocks until the ending block is found (byte zero of the block equals a "Z"). The new memory size is then converted to paragraphs, after which the distance from the ending memory control block to the new end of memory is calculated. This new value is stored in the ending memory control block.

The only task remaining to do is display the results of MEMINIT's operation. Three values are reported: the initial memory size encountered in 40:13 (which is initialized by the hardware switches); the total amount of memory added by MEMINIT; and the new total memory storage used. Notice that if CHKDSK is run after MEMINIT is executed, the new memory is added and is now recognized by DOS.

Knowing how DOS handles memory management will not make anyone a DOS expert, but it is useful and satisfying to understand what is one of the most important features of any operating system.

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Listing 1 MEMINIT.ASM

```
page 60,132
title 'MEMINIT - Obtain all available user memory'
subttl 'Version 1.0 October, 1983'

stack SEGMENT para stack 'STACK'
      db 16 dup('stack   ')
stack ENDS

data SEGMENT at 40H             ; DOS data segment in low memory
         org 13H
         memory_size dw        ; total memory size (K bytes)
         io_ram_size dw        ; memory in I/O channel (K bytes)
data ENDS

code SEGMENT byte

         assume cs:code,ds:code,ss:stack

         original_memory_size  dw ?     ;
         original_io_memory    dw ?     ; all sizes stored in 'K' bytes
         additional_memory     dw ?     ;
         starting_memory_block dw ?     ; location of program's PSP
         command_proc_PSP      dw ?     ; location of command's PSP
                                        ; (PSP=program segment prefix)

         crlf      db 10,13,'$'
         msg1      db 'Original memory used:'
         msg1data  db '       K bytes$'
         msg2      db '  Total memory added:'
         msg2data  db '       K bytes$'
         msg3      db '        Total memory:'
         msg3data  db '       K bytes$'


         heading    db 10,13,'MEMINIT - Version 1.00',10,13
                    db 10,13,'$'

.RADIX 16
         dosfunction MACRO function_number
              mov  ah,function_number
              int  21
         endm

         print MACRO msg, msgdata
              mov  bx,offset msgdata
              call convert_to_ascii
              mov  dx,offset msg
              dosfunction 9
              mov  dx,offset crlf
              dosfunction 9
         endm


   convert_to_ascii PROC far
 ;------------------------

              ; convert_to_ascii converts a binary number
              ; in AX to ascii display characters

         push  dx            ; save register values
         push  si
         mov   cx,6          ; initialize destination with spaces

   fill_buff:
         mov  byte ptr [bx],' '
         inc  bx
         loop fill_buff
         mov  si,0A

   do_divide:
         sub  dx,dx
         div  si                         ; divide AX by 10
         add  dx,'0'                     ; convert remainder to ASCII digit
         dec  bx
         mov  [bx],dl                    ; store this char in the string
         inc  cs                         ; count converted character
         or   ax,ax                      ; all done?
         jnz  do_divide                  ;   no: get next digit
```

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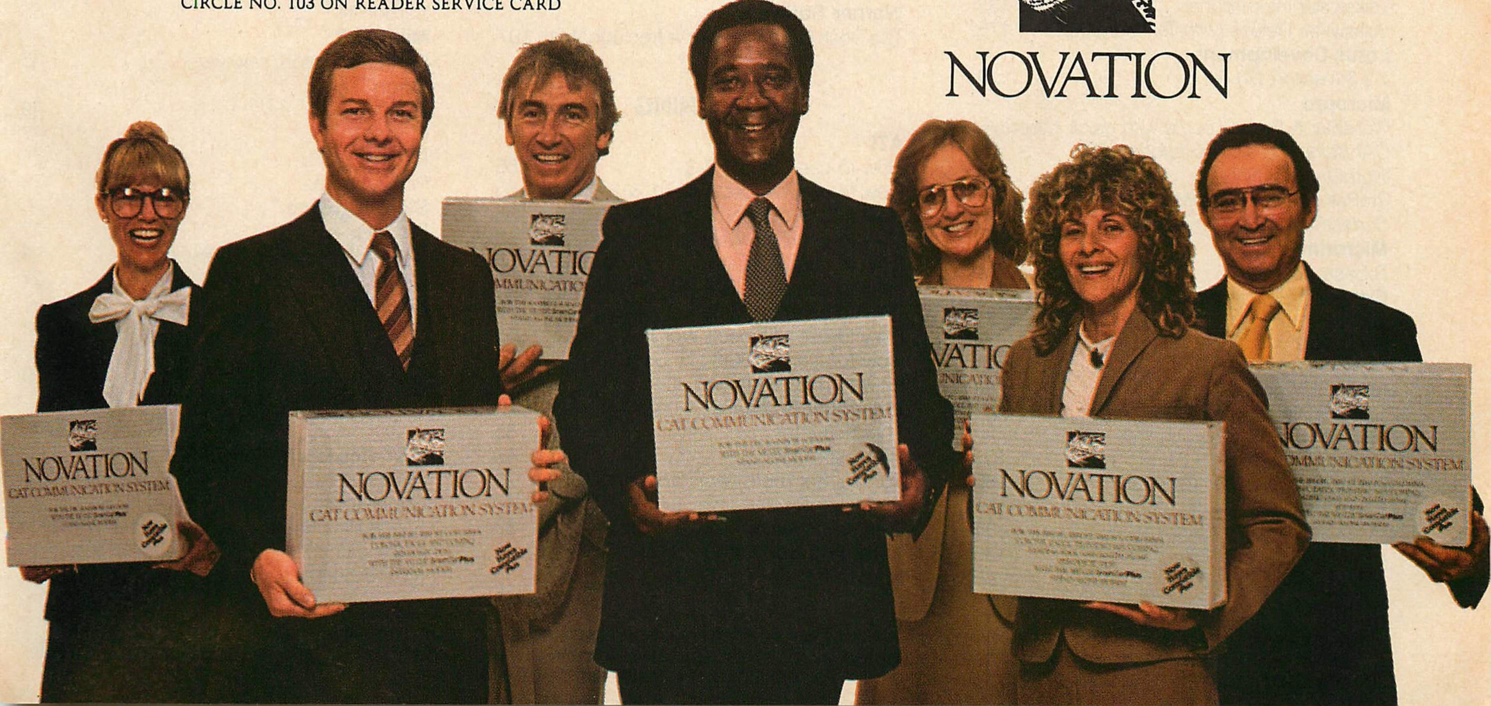

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```
        pop  si                        ; Restore registers
        pop  dx
        ret                            ; and exit

convert_to_ascii ENDP

update_memory_control_words PROC far
;----------------------------------

        assume cs:code,ds:data,ss:stack

        push es
        push ds
        mov  ax,data                   ; Set up DS to reference DOS
        mov  ds,ax                     ;    variables in low memory
        mov  ax,starting_memory_block
        dec  ax                        ; AX points to memory control block
                                       ;    starting at that spot, look for
                                       ;    the end of the memory links
                                       ;    ( byte zero = 'Z' )
find_ending_link:

        mov  es,ax                     ; set up address of mem control blk
        cmp  byte ptr es:[0],5AH       ; Is this the ending link?
        jz   found_the_link
        add  ax,es:[3]                 ; link to next area
        inc  ax
        jmp  find_ending_link

found_the_link:                        ; now update length field of this
                                       ; last mem control block to
                                       ; include the additional memory
        mov  bx,memory_size
        mov  cl,6
        shl  bx,cl                     ; convert to K bytes
        sub  bx,ax
        dec  bx
        mov  es:[3],bx

        pop  ds                        ; restore registers
        pop  es
        clc                            ; indicate normal return (no error)
        ret

update_memory_control_words ENDP

memory_size_initialize PROC far
;------------------------------

     assume ds:code,cs:code,es:data,ss:stack

        mov  cs:starting_memory_block,ds
        push ds
        sub  ax,ax
        push ax
        mov  ax,code
        mov  ds,ax
        mov  dx,es:[0C]                ; COMMAND's program segment prefix
        mov  command_proc_PSP,dx       ;   which we will use to fix up
                                       ;   DOS release 1.1

        mov  dx,offset heading         ; put out introductory heading
        dosfunction 9

        mov  bx,data                   ; get ROM-initialized
        mov  es,bx                     ;    memory size
        mov  ax,memory_size            ;    specifications
        mov  original_memory_size,ax
        mov  bx,io_ram_size
        mov  original_io_memory,bx
        mov  cl,6
        shl  ax,cl                     ; convert from K bytes
        mov  bx,0

memory_loop:

        cmp  ax,0a000                  ; check if greater than
        je   initialize_memory         ;    640K ..if so then end
```

```
        mov  ds,ax
        mov  [bx],ax                    ; write segment # into byte
        mov  cx,[bx]                    ; read segment # from byte
        cmp  ax,cx                      ; if equal..memory exists
        jne  initialize_memory          ;    else no more user memory
        mov  ax,ds
        add  ax,400                     ; increment segment # by 16K
        jmp  memory_loop                ;    and try some more

initialize_memory:                      ; write data into memory so that
                                        ;  parity errors do no occur upon
                                        ;  access of new memory

        mov  bx,memory_size
        mov  cl,6
        shl  bx,cl

        push ax                         ; save the value for AX containing
        pop  dx                         ; the new top of memory.
        mov  ax,0                       ;
        cld                             ; set direction=forward

store_initial_value:

        cmp  bx,dx
        je   end_of_user_memory         ; go through newly allocated mem
        mov  es,bx                      ; and write a pattern of X'0000'
        mov  cx,03fff                   ; into each word.   This will protect
        mov  di,0                       ; against a fatal parity error later
        rep  stosw                      ; when mem is read without being
        add  bx,400                     ; written.(Done 16K bytes at a time.)
        jmp  store_initial_value

end_of_user_memory:

        push dx                         ; restore the value for AX
        pop  ax

        mov  cl,6                       ;  convert from bytes to
        shr  ax,cl                      ;    K bytes
        mov  bx,code                    ;  calculate changed memory
        mov  ds,bx                      ;    sizes and ..
        mov  bx,data
        mov  es,bx
        mov  memory_size,ax             ;    store back ..
        sub  ax,original_memory_size    ;    into DOS variables
        mov  additional_memory,ax
        add  ax,original_io_memory
        mov  io_ram_size,ax


        dosfunction 30                  ; check DOS version
        cmp  al,00
        je   modify_DOS1                ;  pre 2.0 DOS...handle special
```

```
        call update_memory_control_words        ;  routine for DOS 2.0

        jmp  display_results

modify_DOS1:

        push ds
        mov  dx,command_proc_PSP        ; get ready to store new
        mov  ds,dx                      ; memory size in COMMAND's
        mov  dx,memory_size             ; stored variable.
        mov  cl,6
        shl  dx,cl
        mov  ds:[452],dx                ; location of memory size on
        pop  ds                         ;  DOS release 1.1

display_results:

        mov  ax,original_memory_size
        print  msg1,msg1data

        mov  ax,additional_memory
        print msg2,msg2data

        mov  ax,memory_size
        print msg3,msg3data

 exit:
        ret

memory_size_initialize ENDP

code ENDS

END memory_size_initialize
```

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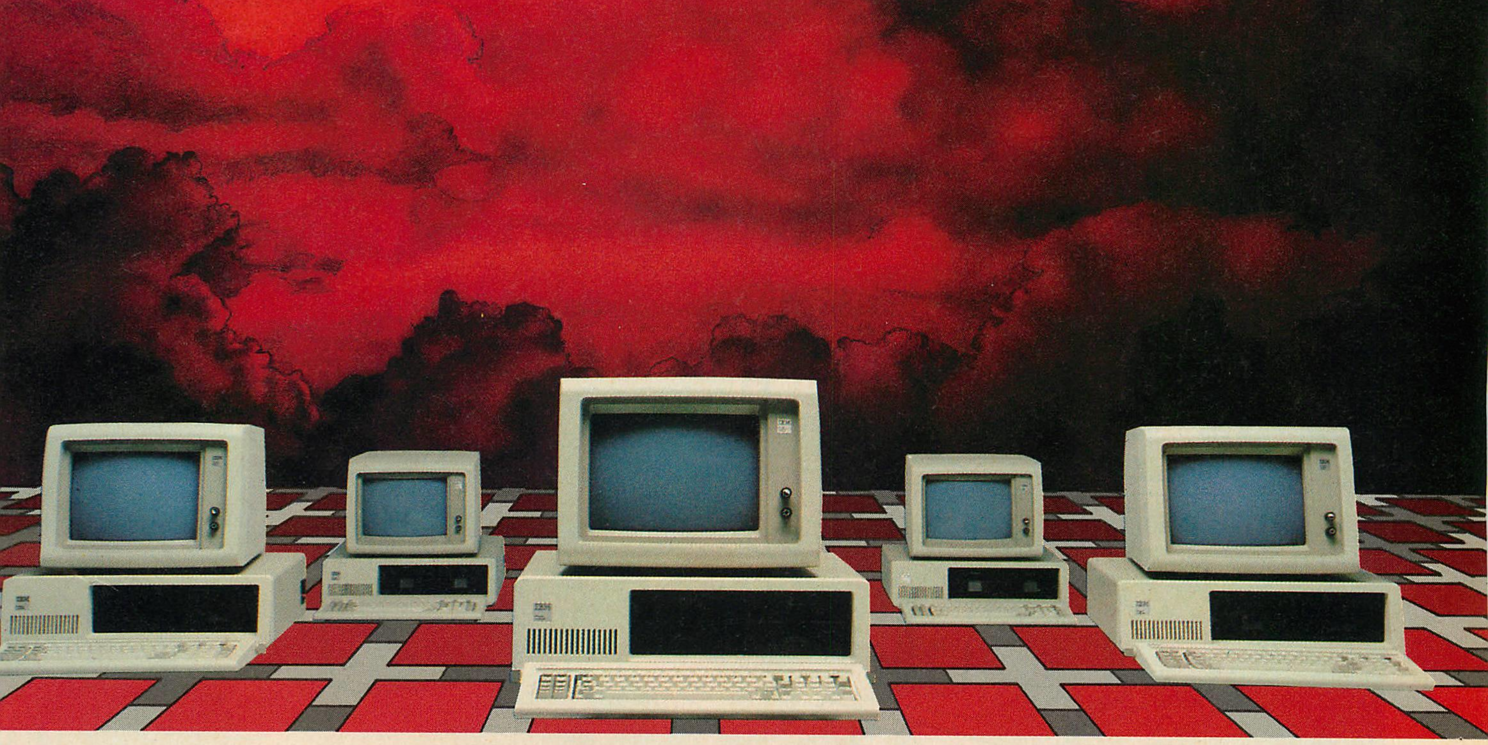

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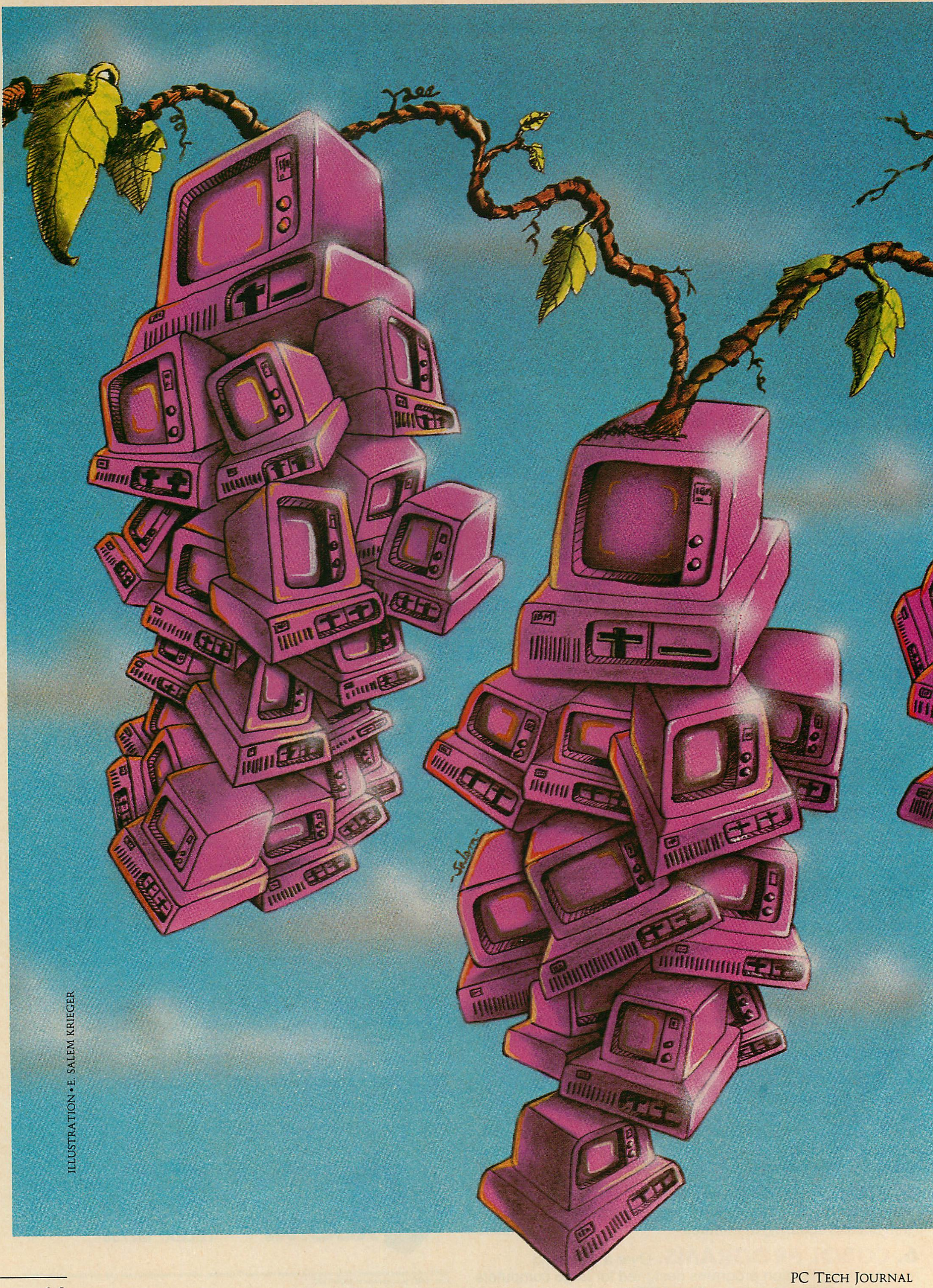


ILLUSTRATION • E. SALEM KRIEGER

CLUSTERS OF WRATH

SUSAN GLINERT-COLE

IBM enters the networking sweepstakes with the Cluster.

On the planet Earth, the philosophy of networking began when some pundit invented the maxim, "Two heads are better than one." On a more galactic scale, readers of science fiction are familiar with a collective intelligence composed of individual sentient units that can share their mental wealth. The majority of networks are designed to emulate the galactic model: all nodes are created equal, but by sharing resources, they are able to blend their individualities into a greater whole.

IBM's first entry into the network community is based firmly on the more restrictive Earth model: a group of heads can exchange information to a minor extent, but they decline to participate in a cosmic oneness.

IBM is purposely not calling the Cluster a network. The primary intent of this product is to permit information transfer between PCs, PC/XTs, PC Portables, and PC*jrs*, while allow-

ing them to share a fixed disk in a limited manner. Up to 64 machines can be linked into a Cluster, but only one can be a disk server. File and message transfer can be performed whether or not the disk server is included in the Cluster.

I/O requests at the server station have a higher priority than do remote requests. Although the shared station can also be used as a workstation, it is suggested by IBM that such use be kept to a minimum during periods of intensive remote input/output. IBM also recommends that the fixed disk serve only as a program repository. Individual stations should download all of the desired software and execute programs locally in order to to maximize throughput in the Cluster.

Each IBM PC, Portable, or PC/XT in the Cluster requires one disk drive (at least one of the PCs or PC/XTs in the Cluster must have a double-sided drive), DOS 2.1, 128K, and an 80-column display. The ROM BIOS module for the IBM PCs in the Cluster must be dated 10/27/82 or later; the manual provides a small BASIC program that will print this date to the display. The BIOS date, however, is not a consideration for the PC/XT, Portable, or PC*jr*, because all of their ROMs postdate this 10/27/82 deadline. The disk server can be either a PC with an expansion chassis or a PC/XT with 256K of memory and one double-sided disk drive.

Each PC*jr* in the Cluster must have at least 128K of memory and an 80-column display. The power supply on the PC*jr* is inadequate to support the Cluster attachment unless the system unit is stripped of the internal modem, the disk drive, and the parallel printer attachment. Even if these restrictions are removed (IBM has stated that it intends to do this), it should be emphasized here that programs that cannot be run on a stand-alone PC*jr*, for whatever reason, will not run on a clustered machine either.

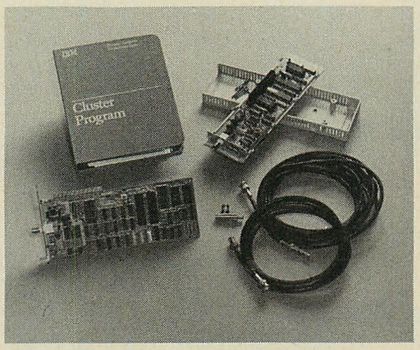


Photo 1: Cluster Components

The Cluster configuration is a linear bus with a data transmission speed of 375K bits per second. The access method is Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). Stations are linked with 75-ohm coaxial cable. The maximum trunk cable length is 1,000 meters; the cable drop length (length from main cable to computer) can be up to 5 meters.

The choice of costly coaxial cable for a low-cost network is especially curious in view of IBM's announcement of a cable scheme for its projected local area network, which will use inexpensive twisted pair wire.

Drop cables are attached to the trunk line with T-connectors, which must be terminated at each end of the Cluster. BNC connectors are used to link the drop cable to the adapter card at each station. The choice of costly coaxial cable for a low-cost network is curious in view of IBM's announcement of a cabling system for its projected local area network, which will use inexpensive twisted pair wire.

The Cluster can be used with four IBM communications programs: the Asynchronous Communications Support, version 2.0; Binary Synchronous 3270 Emulation; SNA 3270 Emulation and RJE Support; and the IBM 3101 Emulation program. A machine must have at least 256K of memory to use these programs with the Cluster. A patch to the SNA 3270 program, provided in the documentation, is required.

The Cluster is not necessarily compatible with IBM software; IBM makes no promises about software that it has not tested and approved for use within the Cluster. A list of programs that will run is available from IBM dealers; at the time of this writing, however, the list was far from extensive. Whether or not a particular application will run in the Cluster requires a more complex answer than just a simple yes or no. This is well illustrated by the fact that the list contains 45 programs and 17 qualifying footnotes.

Programs compiled with the IBM BASIC compiler will *not* run in the Cluster environment. IBM blames the problem on the compiler and provides a free patch for it. The BASIC program needs to be recompiled and relinked with a new library before it can operate in the Cluster. The patch, however, will not help customers who have purchased application programs compiled elsewhere unless a recompiled version has been obtained. Users should be sure to check the vendor documentation carefully.

Other programs can be run from a local disk drive but cannot be run from the shared fixed disk. These products include Multiplan 1.10, EasyWriter 1.10, Dow Jones Reporter 1.0, VisiCalc 1.2, pfs:REPORT 1.05, and pfs:FILE 1.05.

Although the minimum memory configuration for a Clustered machine is 128K, the Cluster software occupies between 20K to 40K, which considerably reduces the amount of memory available for application programs. Some programs that require a minimum of 128K to run (dBASE II, for example) are barely functional in a minimally

configured machine. The situation is even more severe with the PC*jr*, because the video buffer takes between 4K (for black-and-white text mode) to 32K (for four-color, high-resolution graphics mode), leaving about 30K to 50K for programs. Users should remember to take these factors into account before trying to run programs in the Cluster.

instructions. Altogether, the literature fills the standard half-sized binder to overflowing.

If the size of the documentation is formidable, the presentation is perhaps even more frightening, especially for beginners. There is no handy user's guide or command summary reference card. Instead, user and Cluster installation information is mixed together, making it difficult to find information on a particular subject.

The writing style is not aimed at the computer novice either. Some sections of the manual are sterling examples of obfuscating technical language. In fact, the installation instructions were so confusing that the software set-up was successfully completed only after closing the book and pursuing a trial and error course. This was quite a shock, considering the technical accuracy and detail that is usually provided by IBM in its documentation.

Hardware installation involves changing the ROM if required, setting two sets of DIP switches on the adapter cards, plugging the card into each computer (or attaching the sidecar for a PC*jr*), and attaching the cables. All PC*jr*s must be stripped of the internal modem and diskette controller, the power supply must be disconnected from the disk drive, and the printer sidecar must be removed. The instructions for performing these tasks were clear, and no problems were encountered during hardware installation.

Each node in the Cluster must be assigned a unique address from 0 to 63. Physical assignment is done by setting switches 1 through 6 on the first switch block to reflect the binary representation of the address. Switch 8 on the SW-1 is set ON if the station will boot remotely from the fixed disk. It is possible to have one PC, PC/XT, or Portable computer tied to four Clusters at once. Switch block 2, switches 1 through 4, assign the adapter card a number from one to four. If the adapter is the only one present, it must be set to adapter number 1. As soon as the switches are properly set, the adapter card can be installed in any slot in the PC. The PC*jr* Cluster Attachment, like the printer adapter, is connected to the right side of the system unit. PC*jr* participation is limited to only one Cluster.

The integrity of the Cluster, as well as of the cabling and adapter boards, can be tested with the updated diagnostics diskette, or, in the case of the PC*jr*, the new diagnostics included in the adapter ROM.

Table 1: Cluster Diskette Contents

A. Remote Station Diskette

IT.COM	The Information Transfer program loader
VM.COM	Public Volume Manager program
TBL.SYS	Internal use file for the Information Transfer program containing station options and drive access information
PLLSCR.COM	Screen text progam used by IT.COM, DC.COM, AND VM.COM
PDT.COM	Information Transfer program
CONFIG.SYS	This is originally the file REMOTE; it is renamed to CONFIG.SYS by CCOPY
MSG.SYS	An internal use file for the Information Transfer program; used for messages
PCMDP.COM	Protocol command processor used at a remote station

B. Disk Server Diskette

DC.COM	Disk Configurator program
CONFIG.SYS	This file is found on the Cluster diskette as DISK and must be renamed when copied to the fixed disk
DSERVER.TAB	Contains the disk server station index
PCMDISK.COM	Protocol command processor for the disk server station
PUBLIC.COM	I/O driver loaded at reset time

C. Remote System Volume

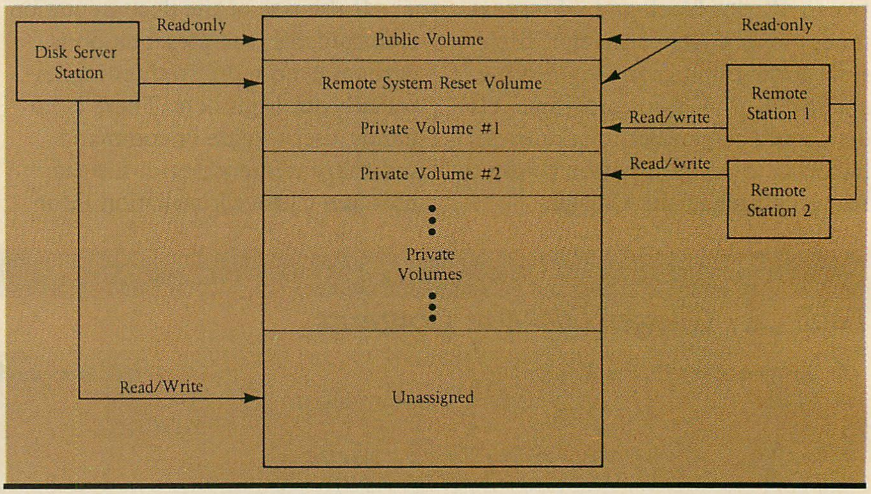
FCONFIG.SYS	This file is found on the Cluster diskette as RIPL. It is renamed during the creation of the Remote System Volume.
RIPLPGM.COM	Resident program that uses the Remote System Reset Volume at the disk server station

SYSTEM SET-UP

The equipment needed to set up a Cluster station must be bought piecemeal (see photo 1). Each station must purchase a software "license" for $92 and a Cluster adapter for $340 ($400 for the PC*jr*). A cable kit, costing $110, is needed for every two machines. Any necessary ROM updates are provided free with the Cluster. The cost for a PC, Portable, or PC/XT station is $487; a PC*jr* station is $547.

The documentation is organized into four "manuals:" Introduction, Disk Server Guide, Public Volume Manager Guide, and Information Transfer Program Guide. The Cluster controller board comes with two separate manuals: an installation guide and an updated diagnostics diskette—with documentation—which includes a test for the Cluster Adapter. The ROM BIOS Update Kit also contains its own installation

Figure 1: Cluster Disk Server Structure



SOFTWARE INSTALLATION

The steps involved in setting up the Cluster software are: installing the Cluster software on the disk server, configuring the fixed disk at the disk server, and making a boot diskette for each computer in the Cluster with a floppy disk drive.

The batch file CCOPY is used to make diskettes for those remote stations that will be booting locally. Table 1 shows the files placed onto the station diskette.

The DSCOPY.BAT file creates a similar diskette for the disk server station (which is useless, because the Cluster files must be on the fixed disk drive), optionally creates the Remote System Volume on the hard disk, and transfers the appropriate files there. It does *not* leave any other relevant Cluster files on the fixed disk, even though the documentation implies that it does. Instead, it creates a temporary directory on the fixed disk, copies the files from the Cluster disk there, transfers these files to the floppy back-up, creates a Remote Rest back-up diskette if desired, and, finally, removes the directory. The Cluster programs have to be copied onto the fixed disk manually using the COPY command.

In addition to PLLSCR.COM, IT.COM, MSG.SYS, TBL.SYS, and PDT.COM, several additional files must be on the Disk Server (see table 1). If there are stations that will boot remotely from the fixed disk, the remote system volume at the disk server must contain the files shown in the last section of table 1.

The software installation process is complicated by very poor documentation. It would appear from the manual that the two batch files, called CCOPY.BAT and DSCOPY.BAT, would do all of the work required to produce station diskettes and to set up the appropriate volumes on the fixed disk. There are problems with these files, however. For example, in order to put files on the fixed disk, the user must format and carefully label four diskettes. This seems reasonable, except that the manual and the batch files do not use these names consistently in the prompts. The batch files copy files from the A: drive to the C: drive. The user receives instructions to place diskettes (the names of which do not agree with the aforementioned labels) into the B: drive; files are then transferred to B: and erased on C:.

Another complaint concerns an aesthetic issue that is important to well-organized people: many of the Cluster files must reside in the root volume of the fixed disk, making a mess out of a neatly structured hierarchical file scheme.

The reason for all this grinding and whirring is that the user is presumed to have only one disk drive; although the documentation never says so explicitly, IBM assumes that the disk server will be installed only on a PC/XT. The installation instructions lead one to believe that the Cluster does not even support the IBM PC and expansion chassis configuration, which would probably have two floppy disk drives.

Another complaint concerns an aesthetic issue that is important to well-organized people: many of the Cluster files must reside in the root volume of the fixed disk, making a mess of a neatly structured hierarchical file scheme.

Once the programs have been properly apportioned on the fixed and floppy diskettes, the fixed disk must be divided into volumes with the Disk Configurator program, DC.COM. Like the other two Cluster programs (the Public Volume Manager and the Information Transfer program), the Disk Configurator program is entirely menu-driven and easy to use.

For the purposes of the Cluster, the fixed disk is divided into four areas, all of which are created with the Disk Configurator (see figure 1). The only input required for volume creation is volume size in 34K byte blocks. If space is available, the volume is created; otherwise an error message is generated.

The first area, called the *public volume*, contains files that are accessible by all the stations in the Cluster. Only one public volume is permitted in the Cluster. All stations

can read and copy files from the public volume, but only the Cluster Manager is permitted to write to it. Therefore, programs that need to open files where their system files are located cannot be executed from the public volume.

The public volume must be created first and must contain at least two 34K byte blocks. The Disk Configurator will copy Cluster files into the public volume at the time of creation if requested to do so.

Another area of the disk contains the *private volumes*; each station, except the disk server itself, is allowed to own one private volume, which is used as an extra disk drive from the remote machine. The private volumes are created by making an entry in the disk server station index that contains the station name, station number, and the size of the private volume. Each station is given access to the public and private volumes by specifying the appropriate permissions in the disk server station index.

The fixed disk can contain an optional area, the *remote reset volume*. System files, Cluster program software, and other applications can be placed here to enable a remote station to boot directly from the shared fixed disk. This volume can contain an application program that is automatically executed from an AUTOEXEC.BAT file on start-up. The size of the remote reset volume cannot, however, exceed the capacity of a dual-sided diskette. This is because of the way the volume is initially created by the batch file DSCOPY.BAT. All files that are to be put into the remote reset volume are placed onto a floppy diskette, and when the volume is created, these files are copied from the floppy to the fixed disk. The remote reset volume is not only write-protected but is also created with no extra bytes. Thus, in order to add anything to it, it is necessary to shut down the Cluster, erase the current remote reset volume, recreate it with the new files, and then bring the Cluster back up.

The fourth area of the disk is unassigned to a volume and can be used by the disk server station.

Once the fixed disk has been configured, the Disk Configurator program is used for maintenance and for altering Cluster parameters: the public volume size can be changed or the entire volume erased, the remote reset volume can be erased, the disk server station index can be edited, a new private volume can be added, and private volume access can be changed. These functions are all available from the Disk Configurator's main menu.

The Public Volume Manager program is used to copy files to and erase files from the public volume. It is executed from the one station designated in the Disk Configurator program as the public volume manager, which can be any station except the disk server. The program is invoked by typing VM at the correct station. The options that are permitted with the Public Volume Manager Program are:

1. display the disk server index
2. copy a private volume file to the public volume
3. copy a disk server file to the public volume
4. copy a file from the public manager station to the public volume
5. erase a file from the public volume
6. make a directory path on the public volume
7. remove a directory path from the public volume

Both the Disk Configurator and the Public Volume Manager are used to copy files to volumes. Because they both change the Cluster volume environment, all Cluster nodes should be rebooted after the desired changes have been made.

The Information Transfer program is central to the Cluster operation. It allows computers to send and receive messages, transmit and download files between computers, display directories of other stations, change the station options, and edit a station index. Thus, although a station can access the public, pri-

Both the Disk Configurator and the Public Volume Manager are used to copy files to volumes. Because they both change the cluster volume environment, all cluster nodes should be rebooted after the desired changes have been made.

vate, and remote volumes on the shared disk without installing the Information Transfer program (these volumes being in essence "local drives"), the Public Volume Manager program, which transfers files between stations, can be run only when the Information Transfer program has been loaded. The Public Volume Manager program is entirely menu-driven and self-explanatory in operation.

Clusters without a disk server cannot have any volumes, but they can still transfer information between stations with the Information Transfer program. Messages and files can be sent and received, and directories at the remote stations can be listed if READ permission has been given.

Messages of up to eight lines, or 512 bytes, can be sent to other stations by selecting the SEND MESSAGE option. An editing screen appears, and the name of the recipient is entered. The user has two options: send to a station (or an alternate if the first station does not reply) or send to all stations (broadcast). The message is then typed into the eight-line field. There is no word wrapping, unless one counts the interesting behavior if the eight-

Table 2: Benchmarks, BUFFERS=4

BENCHMARK TESTS IBM Cluster buffers=4	PC-DOS 2.0	1 user Disk Server	1 user Portable	1 user PCjr	2 users Portable	2 users PCjr
I/O BENCHMARKS (in seconds)						
random access	0:06	0:06	1:20	1:33	2:21	2:21
sequential read/write	0:29	0:45	2:16	2:48	3:03	3:03
sequential read	0:14	0:14	0:23	0:40	0:26	0:44
dBASE sort, 1 key	0:40	0:44	1:24	2:16	1:37	2:20
dBASE Index, 1 key	0:29	0:34	2:35	2:58	4:25	4:27
dBASE Index, 2 keys	0:29	0:34	2:44	3:01	4:23	4:35
WORD PROCESSOR BENCHMARKS						
Word Perfect:						
load wp from hard disk	0:04	0:06	0:20	0:18	0:34	0:28
load wp from floppy disk	0:14	0:12	0:11	*	*	*
exit wp (to hard disk)	0:01	0:03	0:02	0:06	0:04	0:07
load file from floppy	0:04	0:03	0:04	*	*	*
save file to floppy	0:18	0:20	0:19	*	*	*
load file from hard disk	0:02	0:02	0:08	0:27	0:20	0:30
save file to hard disk	0:15	0:16	0:22	1:39	0:33	1:45
WordStar:						
load wp from hard disk	0:06	0:06	0:11	0:16	0:15	0:18
load wp from floppy disk	0:07	0:08	0:08	*	*	*
exit wp (to hard disk)	0	0	0	0:04	0	0:02
load file from floppy	0:03	0:10	0:04	*	*	*
save file to floppy	0:32	0:34	0:32	*	*	*
load file from hard disk	0:03	0:04	0:07	0:11	0:10	0:13
save file to hard disk	0:10	0:10	0:25	1:19	0:42	0:45

line maximum is exceeded: the message wraps to the rest of the fields on the screen. A carriage return terminates the message, which is then sent to the selected recipient. A status message will appear on the screen, informing the sender that the message has been sent, could not be sent, has been sent to an alternate station, or has been sent to all stations.

The last message sent can be called up, re-edited, and sent again if desired. A station must be active on the link to receive the message, but the Information Transfer Program does not have to be running. When a message is received at a station, the computer will beep.

A message file can be examined by selecting option 2 (DISPLAY OR ERASE MESSAGES) on the Information Transfer program's main menu. From the secondary menu, the user is able to display the message log; page through messages inclusively, by date or station; erase messages; and free erased message space for other system uses.

Sending a file to a station requires that the user have write access to that station. The process is accomplished by selecting the SEND FILE option at the main menu. Similarly, receiving a file or reading a station's directory requires read access to that node. Getting a file or directory is done by selecting the appropriate options.

Only one file at a time can be sent or received with the Information Transfer program. The only way to transfer a group of files is to bring down all stations on the cluster, execute the Public Volume Manager at the correct station, copy the set of files from a diskette (or the Volume Manager's private volume) into the public volume, bring the Cluster back up, go to the receiving station, and transfer the files from the public volume into that station's private volume with the DOS COPY command. In a real-life networked environment, such a procedure is unlikely to be used: carrying a diskette from station to station is clearly simpler (except to PCjr).

Option 6 lets a station change the drive access permissions for other computers in the Cluster, change the drive for the station's internal use file, or toggle the bell off.

The station index, which equates a name to a station number, can be edited and displayed by selecting option 7. A station can be added to or deleted from the station index, and the name associated with a station number can be altered.

Instead of providing an integral facility for sharing a printer within the Cluster, IBM has chosen to rely on an inconvenient process described in an appendix. The printer to be "shared" should not be attached to the disk server, as this would degrade Cluster performance. The station with the printer must give public write access to one of its drives and install the DOS print spooler PRINT.COM. If another station wants to print a document, it sends the file, with a .PRT extension, to the shared disk drive. When the operator at the printer station is in the mood to print the files, a simple BASIC program, provided with the Cluster software, is used to send the .PRT files to the spooler and then erase them.

System developers are provided with an assembly language interface for the Cluster program. Application programs can gain access to the Cluster software to copy files from a station and to send files and messages to a station. To call the interface the following sequence is used:

- A parameter control block (PCB) is set up with the ap-

Table 3: Benchmarks, BUFFERS=90

BENCHMARK TESTS						
IBM Cluster buffers=90	PC-DOS 2.0	1 user Disk Server	1 user Portable	1 user PCjr	2 users Portable	2 users PCjr
I/O BENCHMARKS (in seconds)						
random access	0:06	0:07	0:40	1:16	1:06	1:06
sequential read/write	0:29	0:32	1:11	2:27	1:18	1:48
sequential read	0:14	0:14	0:22	0:41	0:25	0:45
dBASE sort, 1 key	0:40	0:43	1:06	2:12	1:09	1:54
dBASE Index, 1 key	0:29	0:30	1:33	2:44	2:13	2:23
dBASE Index, 2 keys	0:29	0:30	1:35	2:48	2:11	2:26
WORD PROCESSOR BENCHMARKS						
Word Perfect:						
load wp from hard disk	0:04	0:05	0:19	0:17	0:33	0:30
load wp from floppy disk	0:14	0:11	0:11	*	*	*
exit wp (to hard disk)	0:01	0:02	0:02	0:03	0:02	0:03
load file from floppy	0:04	0:03	0:04	*	*	*
save file to floppy	0:18	0:20	0:19	*	*	*
load file from hard disk	0:02	0:01	0:08	0:25	0:17	0:26
save file to hard disk	0:15	0:17	0:25	1:38	0:29	1:30
WordStar:						
load wp from hard disk	0:06	0:05	0:11	0:16	0:16	0:27
load wp from floppy disk	0:07	0:07	0:08	*	*	*
exit wp (to hard disk)	0	0	0	0:04	0:01	0:10
load file from floppy	0:03	0:04	0:05	*	*	*
save file to floppy	0:32	0:33	0:35	*	*	*
load file from hard disk	0:03	0:04	0:08	0:11	0:12	0:15
save file to hard disk	0:10	0:08	0:27	0:35	0:38	0:43

propriate structure.

- The Link is activated by the Information Transfer Program.
- The offset:segment address of the PCB is placed in BX:ES. INT 5BH is executed.

All registers except AX are preserved. AL contains a return code: zero for a good return and nonzero for an error. If the high-order bit of a nonzero return code is on, the error occurred at a remote station. A zero in the high bit indicates an error at the local station.

The Cluster uses the foreground stack, and it is the programmer's responsibility to make sure that this stack is large enough for both the foreground and background programs. The message-receive function runs in the background while a program is running the foreground task. Messages are received by the Protocol Command Processor and are then placed on MSG.SYS at that station.

> *We tested the Cluster with six small benchmark programs designed to view network performance with a heavy I/O load.*

PERFORMANCE

During testing at *PC Tech Journal* offices, the Cluster environment proved to be somewhat unstable. Access to private volumes was often erratic, and occasionally the unallocated space on the shared fixed disk would become "write protected" and inaccessible to application programs. At one point, the disk server index became corrupted, necessitating a complete reformatting of the fixed disk and reinstallation of the Cluster software.

Aside from the access problems, the general response of the stations in the Cluster was agonizingly slow. Copying a diskette of files to the public volume took the better part of a half hour. PCjr, not noted for dazzling speed anyway, became positively comatose when connected to the Cluster. Almost every keystroke produced a beep, indicating that the PCjr was too busy to process the keystroke. (See "Inside *jr*," Thomas V. Hoffman, May 1984, page 52.)

In the Cluster software, as delivered from IBM, the CONFIG.SYS files are configured so that BUFFERS=3. Increasing the number of buffers does improve performance. With the disk server configured with BUFFERS=90, for example, many of the benchmarks ran twice as fast as they had done with BUFFERS=4. Each buffer, however, takes up 128 bytes; 90 buffers use 11,520 bytes of the server's memory. If the disk server will be running application programs that require large amounts of RAM, some compromise may need to be made between global Cluster performance and local execution.

We tested the Cluster with six small benchmark programs designed to view network performance with a heavy I/O load (see tables 2 and 3). The random access test wrote 50 records, within a file of 1,000 records, to 50 other records. Each record was 50 bytes long. The sequential read test read 641 lines, each 50 bytes long, within a 40,000-byte file. The sequential read/write test read and then wrote 641 50-byte lines to another file.

The dBASE II benchmarks used 200 records, each containing name, address, telephone number, and zip code fields. These records were sorted on one key, indexed on one

key, and indexed on two keys. The word processor benchmarks were performed with WordStar and WordPerfect (Personal WordPerfect for PC*jr*), in conjunction with a 30,000-byte file.

The programs were run under several different conditions with the Cluster hardware always *in situ*, except for the control tests in the standard single-user PC-DOS environment. User node number one was a Portable IBM PC with 256K memory. The second user node was a PC*jr* set up to boot remotely from the disk server. The shared unit was an IBM PC with 512K memory, a 10-megabyte Apparat fixed disk, and an Epson FX-80 printer.

The single-user tests were done on each unit, while the other user node was off the Cluster. Next, the text were performed with the two remote stations running the benchmarks simultaneously from different volumes on the shared hard drive. The disk server was not used as a workstation while these tests were being performed.

Under PC-DOS alone, the random access test took 6 seconds, the sequential read/write test took 29 seconds, and the sequential read took 14 seconds. Under the Cluster software, performance at the disk server station was only slightly affected, if at all, regardless of the size of the BUFFERS parameter. Remote stations, however, suffered an astounding loss of execution speed. With BUFFERS=4 (see table 2) the Portable, for example, took 1 minute 20 seconds to do the random access test and 2 minutes 16 seconds for the sequential read/write.

When two users simultaneously performed these tests, the performance declined even further: to 2 minutes 21 seconds for the random access; 3 minutes 3 seconds for the sequential read/write; and 44 seconds for the sequential read.

The Cluster software had a similar effect on the dBASE II tests as it did on the random and sequential file tests. Performance on the disk server and on the Portable computer was only slightly affected on all of the word processor benchmarks. PC*jr*, however, had a more difficult time with saving files.

With BUFFERS=90 (see table 3), the performance of the input/output benchmarks was about twice as fast as it had been with BUFFERS=4; this still represents about a three- to sixfold increase over the stand-alone PC-DOS times.

CONCLUSIONS

In the arena of multi-user environments, the Cluster makes a mediocre showing. To begin with, the installation instructions are baffling. And, although the Cluster software is easy to use once it has been installed, it is irritatingly overprotective. For example, the Cluster does not permit a "SuperUser" who can write to any system volumes. This feature would eliminate the tedious chore of using the Public Volume Manager and rebooting all Cluster stations. Small conveniences have been left out: it is not possible, for example, to get a directory of the public volume from within the Public Volume Manager program.

The lack of facility for sending a group of files using the Information Transfer program is a particular inconvenience, and the 512-byte limit for messages restricts communications to terse dispatches, such as "Let me see you in my office," for which the telephone has proven to be effective.

There are other drawbacks to using the Cluster. For example, users cannot efficiently share a printer in the Cluster; the desire to do so is one of the most common reasons for installing a network. PC*jr*s must be stripped of all peripherals, which converts them from semi-serious business machines to limited-memory terminals with excruciatingly slow video update. In addition, the Cluster requires costly coaxial cable instead of the cheaper and more flexible twisted-pair wire used for inexpensive LANs.

To be fair, IBM refuses to call the Cluster a network; it is reserving this term for an arrangement that would provide sophisticated communications.

A more serious problem is that of software compatibility. IBM does not guarantee that its own programs will run in the Cluster, let alone that third-party software will. A company that has spent thousands on word processors, spreadsheets, and data base managers would more sensibly invest a few hundred extra dollars to purchase a network that can run these programs. Similarly, little money is saved by buying the Cluster if expensive peripherals cannot be shared effectively.

To be fair, IBM refuses to call the Cluster a network; the company is reserving this term for an arrangement that permits effective peripheral device sharing and provides sophisticated communications. *PC Tech Journal*, not having a separate category for products such as the Cluster, views the IBM offering as an inexpensive networking environment. Although the price is moderate, the limitations of the Cluster program make it an unattractive alternative to slightly more expensive, but exponentially more powerful, third-party offerings.

IBM Cluster
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CIRCLE 459 ON READER SERVICE CARD

TECH NOTEBOOK 21

A Fix for DOS Users with UNIX Habits

Ease those withdrawal pains with these undocumented UNIX-like features of DOS 2.0

J. ERIC ROSKOS

In many ways, DOS 2.0 is similar to the UNIX operating system. Unfortunately, there are some differences in the command processor that can be frustrating to people who regularly use both DOS 2.0 and UNIX: the symbol used to separate directory names under 2.0 is a backward slash (\); whereas under UNIX it is a forward slash (/); the symbol used to denote a command switch under DOS is a forward slash, whereas under UNIX it is a dash; and device names under DOS consist of a string of characters followed by a colon—for instance, CON: or PRN:—rather than the form used under UNIX—/dev/con and /dev/prn.

These differences can be eliminated. DOS already recognizes forward as well as backward slashes at the DOS function call level; the only reason file names can't have forward slashes is that the command processor interprets a forward slash as the command switch character. An undocumented command can be used to get the command processor to interpret some other character as the switch character.

Chapter 9 of the DOS manual contains descriptions of commands that can be included in the file CONFIG.SYS. Among those commands is one of the form

SWITCHAR=x

If this command line reads

SWITCHAR=-

the command processor will take a dash, instead of a forward slash, as the switch character. After this change is made, the forward slash may be used as a directory name separator, and the dash may be used as the switch character, exactly as in UNIX. Furthermore, the command processor will keep track of which kind of slash was used last, and it will use that character whenever it has to print a slash as part of a directory name.

Why was this command not documented? Probably to make the documentation simpler. The switch character is used throughout the manual in the description of commands; it would be annoying to have to include, everywhere the slash is used, a footnote saying "or, the current character assigned by the SWITCHAR command." Such a note would be necessary, however, to avoid confusing novice users.

Further, confusion could result if, on a system used by more than one person, each user chose his own switch character. The omission is therefore understandable, at least for the introductory parts of the DOS manual. (For another reason for this omission, see Dan Frank's article on the DOS RESTORE command in this issue.)

There is one other, less forgivable, omission that affects the operation of programs written using calls from the new Xenix-compatible (hence UNIX-compatible) Version 2 system. UNIX writes device names as /dev/name. There is a good reason for this: the syntax is identical to that of a file name, and the name can be used in an OPEN system call to open a device or a file, without special distinctions.

According to the manual, however, DOS writes device names as NAME:. If such a name is used in the UNIX-compatible OPEN function call (DOS call 3D), the open will fail. A careful reading of the manual reveals (on page D-15) that all the devices are pre-opened; the user might conclude that he is expected to use these pre-opened file descriptors instead of doing an OPEN call. Anyone who designs programs according to the UNIX principles will not find this to be acceptable: in general, there is no reason why a user shouldn't be able to open a device just as he does a file, as long as sequential character I/O is given to the device. Using the pre-opened file descriptors complicates this considerably.

Again, the failing here is only in the manual. DOS *does* allow file names of the form /dev/name, and these names *can* be used in an OPEN system call, in which the documented names would fail.

These undocumented features can make DOS 2.0 more pleasant to use for people who are accustomed to UNIX. Like all undocumented features, however, they must be used with discretion; they could be deleted in a future release. For the sake of UNIX users, I hope that they will be retained, if not improved upon, in future releases.

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JULIE A. ANDERSON

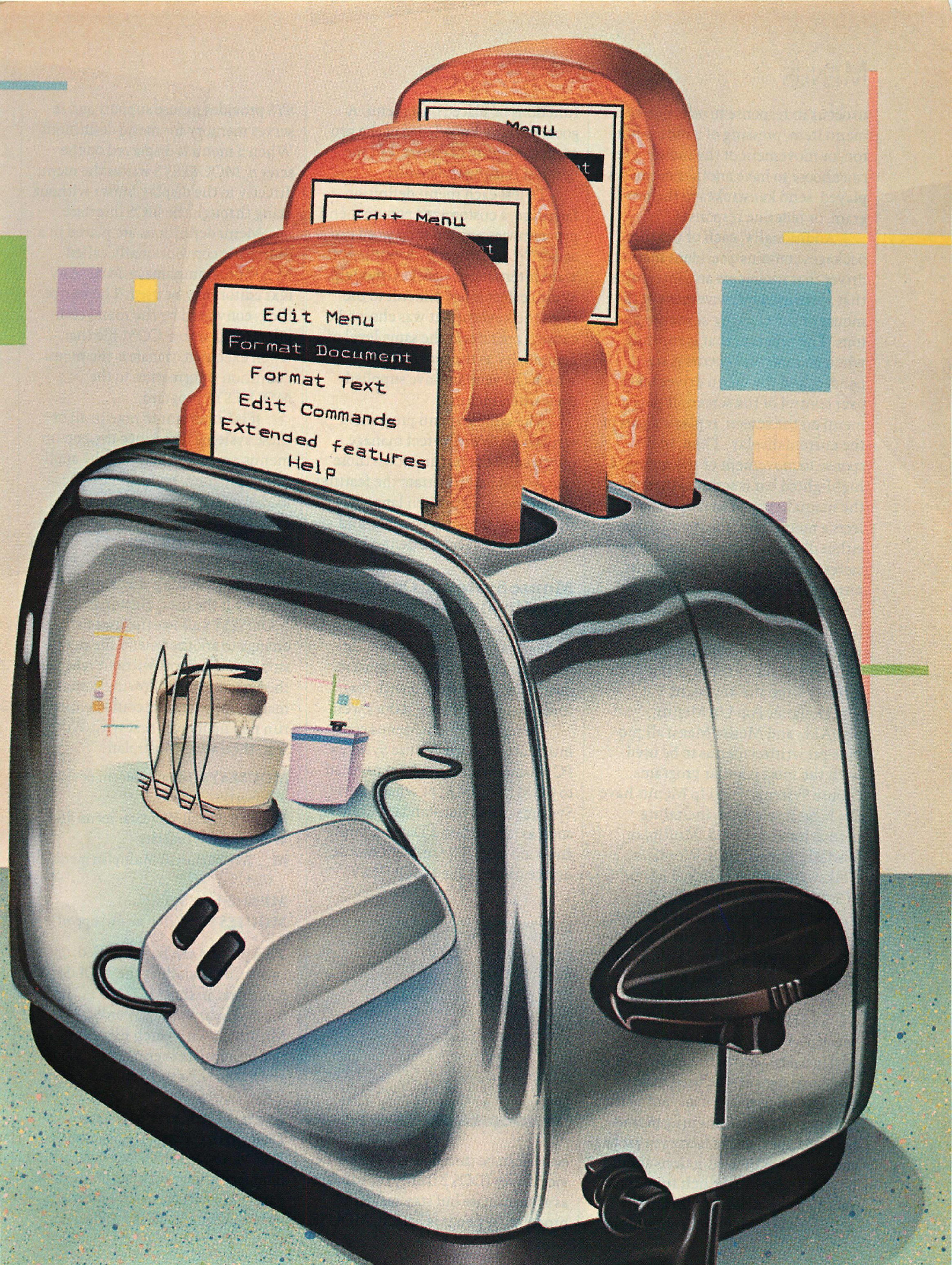
POP (UP) GOES THE mouse menu

Menus to use with mouse packages are popping up all over. Here are three from Mouse Systems, Trillian, and Microsoft.

For the PC operator who would choose to take a multiple-choice rather than an essay exam—even an open-book essay exam—mouse pop-up menus are made to order. Like a multiple choice test, a mouse and a pop-up menu will lay out all the options. The user need not remember the syntax of commands or even which function keys to press. Program commands are placed on menus that "pop up" on the screen when a mouse button is pressed. Customized keyboard overlays and key labels can be thrown away, and typos are almost eliminated.

The mouse pop-up menu software packages reviewed in this article, Designer Pop-Up Menus from Mouse Systems, visuALL from Trillian, and Mouse Menu from Microsoft, have some features in common. In each, the mouse menu driver manages the display of menus and the selection of menu items. The user has merely to specify what action is

ILLUSTRATION • KATHY STAICO SCHORR


Edit Menu
Format Document
Format Text
Edit Commands
Extended features
Help

to occur in response to selection of a menu item, pressing of a mouse button, or movement of the mouse. He can choose to have another menu displayed, send keystrokes to the program, or redefine responses.

Additionally, each of the three packages contains a resident menu driver that intercepts any interrupts that are caused by movement of the mouse or the clicking of mouse buttons. The program that is running when an interrupt occurs is suspended, and the menu driver takes over control of the screen. It puts a menu on the screen, replacing part of the current display. Then, in response to movement of the mouse, a highlighted bar is scrolled through the menu items. When the user selects a menu item, the menu driver either displays another menu or restores the original screen contents, inserts keyboard scan codes into the keyboard type-ahead buffer, and relinquishes control. All this is invisible to the application program, which receives its input as if it came directly from the keyboard.

Designer Pop-Up Menus, visuALL, and Mouse Menu all provide prewritten menus to be used with the most popular programs. Mouse Systems' Pop-Up Menus have the biggest selection, including menus for Lotus 1-2-3, Multiplan, VisiCalc, SuperCalc 3, WordStar, Volkswriter, IBM Personal Editor, PFS: Write, and Multimate. VisuALL is delivered with a DOS shell, and menus for Lotus 1-2-3, WordStar, IBM Personal Editor, and Multiplan can be added for $49.95 each. Microsoft furnishes Mouse Menus for WordStar, Lotus 1-2-3, Multiplan, and VisiCalc.

In each system, the menu definition languages can be used to write customized menus for any software not supported. In designing menus for a program, many factors must be considered: which functions should be put on a menu, which functions should be grouped on the same menu, and in what order should the functions be placed on a menu. A good working knowledge of the program is helpful, of course, but the best test is using the menus.

To test each menu-definition language, a customized pop-up menu program was written for a word processor, WordPerfect by Satellite Software International (SSI). Although WordPerfect is not difficult to use from the keyboard, it was chosen because it operates at the same level of complexity as the programs for which the vendors have supplied prewritten menus.

The sample menu programs written for WordPerfect manage only a subset of its functions: those that would best illustrate the features of each menu-definition language, the variety of menus possible, and the actions that can be defined.

Mouse Systems' Designer Pop-Up Menus

Of the three languages reviewed, Mouse Systems Designer Pop-Up Menus is the simplest and most robust. It isn't overloaded with features, but what it does, it does well.

Designer Pop-Up Menus communicate with the Mouse Systems PC Mouse, which can be connected to COM1:, COM2:, or what Mouse Systems calls a nonstandard COM2:, such as is found on a Davong multifunction card. The resident mouse device driver, called MOUSESYS, either can be installed as a system device driver (DOS 2.0 only) or can run as a "terminate but stay resident" program. When it is loaded, MOUSESYS provides mouse support and reserves memory for menu definitions. When a menu is displayed on the screen, MOUSESYS writes the menu directly to the display buffer without going through the BIOS interface.

Of the three languages reviewed here, Mouse Systems is the simplest.

Menu definitions are placed in a source file conventionally called M_<programname>.MSC. Any text editor may be used. The source file is converted by the menu compiler, MSC, into a .COM file that, when executed, transfers the menu definition information to the MOUSESYS program.

It is important to note in all of these systems that, since the pop-up menus are independent of the application program, once a menu file is loaded it will continue to operate even after the corresponding application program terminates. The burden of assuring that the appropriate menu program is running at any given time rests with the user. Fortunately, MOUSESYS allows the user to change to another menu file or to stop menu support without rebooting the system. The following commands, for example, could be used to run pop-up menus first with WordStar, then with Multiplan:

MOUSESYS (Install resident device driver)
M_WS (Install WordStar menu file)
WS (Invoke WordStar)
M_MP80 (Install Multiplan menu file)
MP80 (Invoke Multiplan)
MOUSESYS/S (Stop menu support)

This process can be simplified, of course, by including the MOUSESYS command in the AUTOEXEC.BAT file and by invoking WordStar or Multiplan with batch files that load the appropriate menu, run the program, and then stop mouse support.

Menu Definition for Designer Pop-Up Menus

The Mouse Systems menu-definition language allows the user to set global parameter values, specify cursor or button response, define menus, and

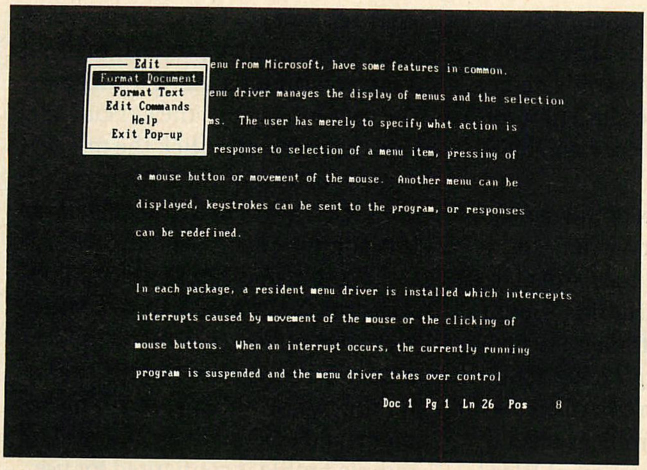


Photo 1: Main Edit Menu for Designer Pop-Up Menus

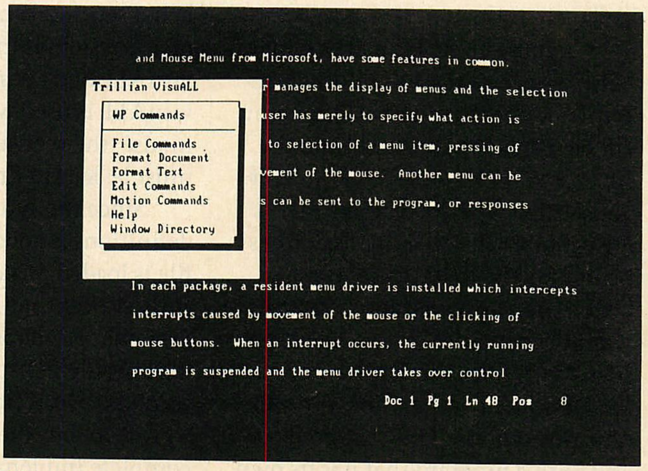


Photo 2: Main Menu for visuALL

describe initial mouse settings. A comment statement identifying the menu file can also be defined and will be displayed when the menu file is loaded. Explanatory comments and white space are permitted throughout the source file. All of these features render a simple and readable language, as illustrated in the sample menu definition file for WordPerfect that is found in listing 1.

The MOUSE definition statement at the end of listing 1 identifies statements that set the initial values of the left, middle, and right buttons and the response to mouse movement. For WordPerfect, the left button invokes the main edit menu (photo 1), the middle button invokes the motion menu, and the right button invokes the file commands menu.

Object definition statements take the following form:

label: Object name
(action-statements)

where action statements can be a combination of menu statements (display a menu), key statements (send keystrokes to program), and button statements (change the definition of a button).

Global parameters control the screen location and display attributes of the menu and the sensitivity of the mouse. The menus can be centered about the current location of the hardware cursor or displayed in a fixed place on the screen.

The cursor definition statements specify what to do when the mouse is moved. Normally, the user is inclined to make the motion of the mouse cause movement of the cursor in the corresponding direction. In listing 1 the Arrowkeys statement indicates that the corresponding cursor arrow keys are to be sent to the program when the mouse is moved. It is possible, however, to make mouse motion cause cursor movement in the opposite direction, or in a perpendicular direction, although this is considered user-unfriendly.

In the menu statements each menu is given a title. For each item on the menu, some identifying text is defined, along with the action to be taken when the item is selected. The Designer Pop-Up Menu software automatically generates a no-op "exit" item that discharges the menu without taking any action. In addition, each time a menu is displayed, the highlighted bar is positioned over the item chosen the last time the menu was presented. This makes possible what Mouse Systems calls "mousing ahead"—two clicks of the mouse button repeats the action that was defined by the last selection.

If keystrokes are to be inserted into the type-ahead buffer, they are specified using the key statement. Text is enclosed in quotes, and through a very pleasant design feature of Designer Pop-Up Menus, every key on the keyboard can be identified using a logical name—in most cases, the same legend printed on top of the key. To specify the Shift, Alt, or Ctrl forms of a key, the key name is prefaced with *s-*, *a-*, or *c-*.

Keys can also be identified using scan codes, but this is unnecessary since all of WordPerfect's commands can be expressed by giving the logical key name, even though WordPerfect requires some unusual key combinations, such as Ctrl-Enter (to form a new page). Mouse Systems' menu file can handle all the key sequences in the same file with no trouble.

Button-definition statements assign actions to the clicking of buttons. Normally a menu is displayed. Since menus can be nested—that is, selecting an item from one menu can cause another menu to be displayed—the question becomes which menu should be displayed the next time the button is clicked. If all menu items are grouped according to a particular mode of operation, such as editing or file commands, then once the menu is selected, it should be displayed each time the button is clicked until the user exits that operating mode.

Mouse Systems calls this a *sticky menu,* and it is easily induced by changing the definition of the button that invokes the menu. Initially, when the left button is clicked in the sample program, the main menu is

displayed. If the item Format Document is chosen, the FormatDoc menu is displayed and the left button is redefined so that the FormatDoc menu will be displayed the next time the left button is clicked. But beware of mousetraps! The FormatDoc menu must contain an item that redefines the left button to its initial state, or the user can never escape from the FormatDoc menu. This escape item is Go to Main Menu in listing 1.

Designer Pop-Up Menus have some limitations. They cannot be used with a program that has its own keyboard interrupt handler. Also, since the keystrokes are pushed into the type-ahead buffer, a maximum of 15 keystrokes can be sent to the program at one time. (This doesn't seem to be a serious hindrance, however.) The menus can be used on either a monochrome or color display in text mode only. Mouse Systems claims that the minimum memory use is 11K; however, the sample menu-definition file in listing 1 generated 3,548 bytes of menu data and used just over 9K when booted up.

The documentation is quite good, aimed at people who are somewhat familiar with the PC. It has an especially sagacious section on menu design considerations.

Trillian visuALL

VisuALL is a powerful package that is rich in features; unfortunately, it doesn't allow definition of all possible key sequences. If Trillian can correct these problems, this will be a super pop-up menu system.

The only package not supplied by a mouse manufacturer, visuALL supports a variety of other vendors' mice, including Microsoft, LogiTech, and Mouse Systems, and it can even be used without a mouse. I tested visuALL with the Microsoft mouse and Mouse Systems' PC Mouse and did not have any problems.

With visuALL, the menu definitions are stored in files called *profiles*, which are passed directly to the resident menu driver without being separately compiled. The menu system is installed by invoking visuALL and giving a profile name. If visuALL is used with the Microsoft mouse, the mouse driver, MOUSE, must be loaded first.

Since the syntax of the menu definitions is checked when the profile is loaded, installing visuALL is a little slower than installing Mouse Systems or Microsoft menu systems. The profile in listing 2 takes about 10 seconds to load from a hard disk—not a big deal, but the profile is not a complete implementation of WordPerfect. The big drain on resources is memory use; the same profile uses almost 42K (without the DOS shell). VisuALL offers more functionality than any of the other mouse menus.

VisuALL is a powerful package that is rich in features; however, it doesn't allow definition of all possible key sequences.

Each time a different profile is used or the mouse is moved to a different com port, the system has to be rebooted and visuALL reinstalled. Shells can be combined into one profile, so that, for example, WordStar and Lotus 1-2-3 both could be run without rebooting; that would require more memory and a longer initial boot-up time.

Menu Definition for visuALL

VisuALL command menus, also called *windows*, are always displayed in the top left corner of the screen with a highlighted background. Photo 2 shows the main menu generated by the sample profile. To dismiss a menu without making a selection, the user must move the cursor outside the menu and click the mouse button. By default, command menus are sticky; when a menu is displayed, it becomes the current window.

As shown in the sample profile in listing 2, the profile initialization section contains a definition of the mouse being used and initial values for the mouse buttons, cursor movement, and keyboard use, if any. The sample profile is configured for use with the Mouse Systems' PC Mouse on COM1:. Actions can be assigned to as many as four buttons depending on which mouse is used. Unfortunately, since it is not possible to assign an action to the simultaneous clicking of both Microsoft mouse buttons, the use of the Microsoft Mouse is limited. In listing 2, clicking the first button (select) will display the current command window, whereas clicking the second, third, or fourth button will send the Enter character to WordPerfect.

VisuALL allows conditional execution of statements depending on the screen location of the cursor. The cursor command in the sample profile specifies that mouse movement should be reflected in cursor movement, unless the cursor moves into the last row on the screen. In that case, the cursor should "fly"; that is, the cursor should move on the screen without the program being aware of its movement. This is a very handy feature for WordPerfect.

When the visuALL DOS shell is loaded, F1 can be used in the same way as the select button on the mouse, and F2 the same as the mark button, so that visuALL can be used without a mouse. With this configuration, these keys are no longer available to the application program. Because WordPerfect uses the F1 and F2 keys, the select and mark values were equated to "no- action" in the sample file so the keys could be used to invoke the WordPerfect functions.

The Shell command defines a set of window definitions typically used for one program. A profile can contain multiple shells, but cannot exceed 48 window definitions.

Because visuALL uses an intermediate buffer to hold keystrokes before they are put into the type-ahead buffer, it allows up to 60 characters to be passed to the application program instead of the 15-character limitation imposed by the other menu systems. Like Designer Pop-Up Menus, visuALL allows typewriter keys to be written in single quotes and other keystrokes to be defined using logical names. A narrower range of values is supported by visuALL, however. It would not accept the Alt form of the +/= key or the Ctrl-2 combination. Although specifying *linefeed* (for Ctrl-Enter) and *home backspace* appears to generate the correct codes, they did not work with WordPerfect.

In WordPerfect many key combinations do not directly invoke the desired function, but cause the word processor either to prompt the user for more specific information or to display a menu from which the desired function can be selected. If only the first layer of selection is implemented in a pop-up menu system, then some functions will be chosen using pop-up menus and other functions will need to be selected using keyboard input. The user may be confused about when the pop-up menus are supposed to be used. Implementing functions as completely as possible in the mouse menu system gives continuity and cohesion to program execution.

VisuALL offers such a wide range of actions in response to menu item selection that it is possible to add this second layer of implementation to the menu definitions. All of the actions provided in the Designer Pop-Up Menu system are also available here, as well as many more. For example, three types of prompts are supported. The simplest form prompts the user for text input that is passed directly to the program. This type of prompt is used in the sample profile (listing 2) in the format document window. To set margins, a Shift-F3 is sent to WordPerfect (the Set function), which invokes a menu from which item 3 is chosen (Set Margins). VisuALL prompts for the left and right margin settings and passes them to the program. Thus, the complete function is performed using the pop-up menu system.

> *If only the first layer of selection is implemented in a pop-up menu system, then some functions will be chosen using pop-up menus and others will need to be selected using keyboard input.*

In the silent prompt, "sprompt," the user's response is not passed to the program, but can be used to conditionally execute action statements. This type of prompt is illustrated in the file commands window in the save text action statements. If the user's response is *y* to the prompt "Save to current file," then a *y* is passed to the program. Otherwise, the user is prompted for the file name, which is sent to the program instead of the current name.

The last form of prompt, *fprompt*, is used in the file commands window for the retrieve text action statements. It displays, in menu format, a directory of file names on diskette. If all file names do not fit on one menu display, they can be scrolled into and out of the display window, until the desired file name is found. VisuALL displays the current directory for drives a:, b:, and c:.

As mentioned earlier, it is possible to "fly" the cursor—that is, move the cursor on the screen without sending cursor movement commands to the program. This feature can be used to implement a soft function key. In the sample program, again in the file commands window, the action statements for Print Text use this feature. The cursor definitions have specified that when the cursor moves into the last line on the screen, it is to fly. When Print Text is invoked, WordPerfect displays a minimenu on the last line of the screen, with the selections Full Text Print, Page Print, and Change Print Attributes. The user simply moves the mouse until the cursor is over the appropriate text and then presses the mark button. The action statements conditionally define the value of the mark button based on the cursor's location when the button is pressed.

Documentation for writing application shells is included with the Design Kit, which is purchased separately. Aimed at the novice user, it never reaches the precision that is necessary to implement a menu definition with confidence. Menus are best written by referring to the examples in the book and experimenting with different statements.

Microsoft Mouse Menu

The flexibility that Mouse Menu allows in the design and placement of menus is this package's strong point. Mouse Menu is especially good if an application program requires different input depending on its current operating mode.

The Microsoft Mouse Menu definitions are stored in a source file (.DEF extension) that, like that in Designer Pop-Up Menus, is converted into menu code (.MNU extension) by the utility MAKEMENU. To install the menus, the resident mouse driver, MOUSE, is loaded

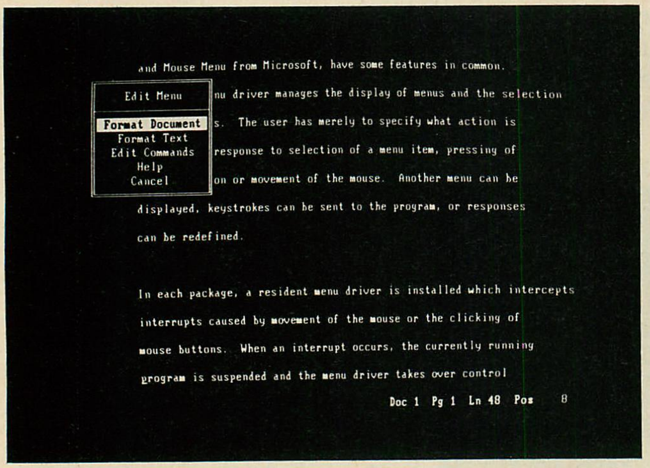


Photo 3: Main Menu Created by Mouse Menu Definition File

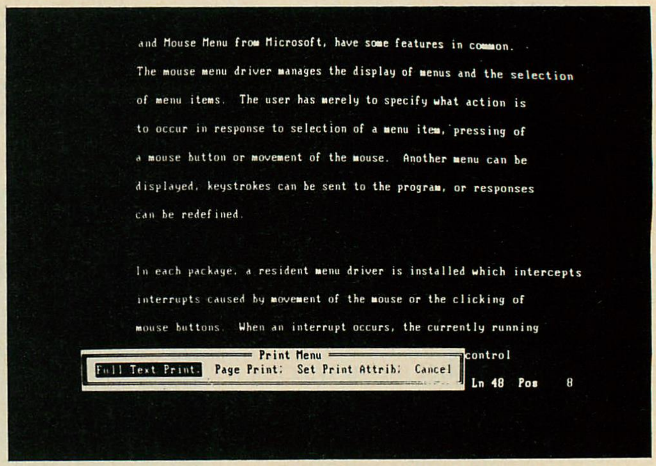


Photo 4: PrintTextPopUp for Mouse Menu

(Mouse Menus can only be used with the Microsoft Mouse), after which the resident menu driver, MENU, is invoked and given the name of the menu file. Rebooting is not necessary to change the operating menu file or to disable menu support; the MENU command can be issued with a different menu file name, or the command MENU OFF can be given.

Mouse Menu has a few restrictions. It cannot be used with programs that have high-resolution graphics or directly handle the mouse. Also, Mouse Menu definition files can have a maximum length of 6K after compilation. The sample menu definition file in listing 3 compiled to a file about 3K bytes long, and, together with the mouse driver, required 13K when loaded.

The Microsoft mouse comes with its own hardware interface board that can be installed in any available slot. Some Microsoft mice were improperly configured for use with a fixed disk. The problem was in jumper block J4, where the jumper should have been on jumper pin pair 2, not 5. Microsoft is aware of this problem, has corrected it, and has notified dealers of the fix.

Menu Definition for Mouse Menu

The first statement in a menu-definition file, BEGIN, defines the initial settings of the mouse by specifying mouse sensitivity and supplying the labels of statements to be executed in response to mouse movement and button clicking. An action can be assigned to the simultaneous clicking of both buttons—an effective way to overcome the Microsoft mouse two-button limitation. These initial settings can be redefined later using the ASSIGN statement.

Each menu can be placed anywhere on the screen by specifying the beginning cursor coordinates and can be displayed with the normal, inverse, or bold attributes. Two different types of menus are supported in the Mouse Menu package: the single-column menu, defined with option-action pairs; and a multiple-column pop-up menu that can be created using text and graphics characters. Photo 3 shows the main menu that was created by the sample Mouse Menu definition file in listing 3.

The single-column menu will display as many as 20 items, but it is the user's responsibility to assure that the beginning cursor coordinates specify a row that allows all the items to fit on the screen. As the manual states, "Otherwise, one or more menu items are displayed off the screen." (Quite a feat!) The user must also assure that a Cancel item is defined for dismissing the menu without making a selection. This is created by specifying option text with no corresponding action. Of course, an Escape item must be defined for exiting sticky menus. Unlike in the other two menu systems, when a menu is displayed the last item selected is not highlighted, so mousing ahead is not possible.

The pop-up menu allows the definition of multi-column, variable-width menus or message boxes. It is possible, for example, to create a pop-up menu that extends the entire screen width. TEXT statements are used to build the custom menu in the desired shape. Borders for these menus are user-supplied and may be created using graphics characters. SELECT statements specify the selection areas on the menu by giving row and column coordinates relative to the beginning of the pop-up menu. "PrintTextPopUp" in listing 3 (shown in photo 4) combines text and graphics characters to create a pop-up menu that implements the print menu for WordPerfect.

In menus of both the single-column and pop-up types, the label of a statement to be executed is given for each selection item. This may be a MENU, POPUP, ASSIGN, MATCH, or TYPE statement. Or, a series of actions can be specified with an EXECUTE statement.

The TYPE statement defines as many as 15 keystrokes to be sent to the application program. In contrast to the other menu systems, only a few of the special function keys (En-

ter, Tab, Backsp, and Esc) have been given logical names. All keystrokes other than the typewriter keys must be identified using scan codes. This unfortunate design does not allow any more flexibility in expressing key combinations than the Designer Pop-Up Menus package does, makes the menu definition file less readable, and causes unnecessary work for the user, who must look up each scan code (even those, like up-arrow, that are used in all menu definition files). As in visuALL, the keystrokes Crtl-Enter and Home followed by Backspace appeared to be sent correctly to WordPerfect, but the corresponding functions did not work.

The MATCH statement, on the other hand, is quite useful for an application program that has operating modes. Using this statement, actions can be executed conditionally, depending on what text is displayed on the screen. ASCII strings up to 255 characters long can be matched beginning anywhere on the screen. Two statements labels are given as parameters to the MATCH statement—one is to be executed if a match is found, the other is to be executed if no match occurs.

Microsoft uses the MATCH statement in its WordStar menu to distinguish between the file and no-file modes. However, some maintenance problems surfaced when the screen display was changed in WordStar version 3.3. A simple fix can be applied to the existing WordStar Mouse Menu so it can be used with version 3.3; in the future, through an arrangement between Microsoft and MicroPro, the appropriate Mouse Menu will be shipped with every version of WordStar.

Mouse Menus are supplied with a 60-page pamphlet containing instructions on using the prewritten menus, as well as on writing customized menu definitions. A tutorial section, combined with a precise reference section and the sample prewritten menus, simplifies the process of writing menu definitions. Microsoft could have helped the user more by including an appendix that lists the keyboard scan codes rather than referring the user to Appendix G in the BASIC user's manual.

Rating Mouse Pop-ups

As is the case with many software packages, deciding which mouse menu system is best depends on the user's needs and technical prowess.

Mouse Systems' Designer Pop-Up Menus are beautifully and simply designed. The system is easy to use and menu programs are easy to write. This is the best choice for the user who wants to implement an uncomplicated interface. A novice user is more likely to understand Designer Pop-Up Menus than the other systems reviewed here.

Trillian visuALL delivers a lot of power without supplying much flexibility in menu design. It uses more memory than the others but is rich in functionality and can be used with a variety of mice or with the keyboard alone. Its more complicated language structure makes visuALL difficult for the novice to understand.

A novice user is more likely to understand Designer Pop-Up Menus than the other mouse menus reviewed here.

Microsoft Mouse Menus are best used when control over physical menu design and screen placement is required, or with an application program that requires different input depending on its current operating mode.

Designer Pop-Up Menus 3.0
Mouse Systems Corporation
2336H Walsh Avenue
Santa Clara, CA 95051
408-988-0211
$295 (with PC Mouse and software)
$95 (software only)
Menus included for Lotus 1-2-3, WordStar, IBM Personal Editor, Multiplan, VisiCalc, SuperCalc 3, Volkswriter, PFS:Write, Multimate
CIRCLE 463 ON READER SERVICE CARD

visuALL 3.09A
Trillian Computer Corporation
P.O. Box 481
Los Gatos, CA 95030
408-358-2761
VisuALL with DOS Shell $99.95
VisuALL Design Kit $49.95
VisuALL Shells $49.95 each
Shells available for Lotus 1-2-3, WordStar, IBM Personal Editor, Multiplan.
CIRCLE 462 ON READER SERVICE CARD

Mouse Menu 200.101
Microsoft Corporation
P.O. Box 97200
10700 Northup Way
Bellevue, WA 98009
800-426-9400
In Washington state call
206-828-8088
$195 (includes mouse and software)
Menus included for Lotus 1-2-3, WordStar, Multiplan, VisiCalc
CIRCLE 461 ON READER SERVICE CARD

Listing 1 Mouse Systems Designer Pop-Up Menus

```
Comment  ("Configured for Word Perfect (version 3.0)")

;
;       Parameters
;
Sensitivity     (13, 8)
Hysteresis      ( 1, 1)
ReverseVideo    (Yes)
FixedMenu       (No)
EnableBeep      (No)

;
;       Cursor Definitions
;

Arrowkeys:  Cursor
(
        Left    ([Left])
        Right   ([Right])
        Up      ([Up])
        Down    ([Down])
)

;
;       Button Definitions
;
; Initial Settings for Left, Middle, and Right Buttons
LBO:    Button  (Menu (Main))
MB:     Button  (Menu (Motion))
RB:     Button  (Menu (FileCommands))

; Redefinitions for Left Button
LBFD:   Button  (Menu (FormatDoc))
LBFT:   Button  (Menu (FormatText))
LBEC:   Button  (Menu (EditCommands))

;
;       Menu Definitions
;
Main: Menu
(
 Title ("Edit")

 Item ("Format Document", Menu (FormatDoc), Button (LBFD))
 Item ("Format Text", Menu (FormatText), Button (LBFT))
 Item ("Edit Commands", Menu (EditMenu), Button (LBEC))
 Item  ("Help", Menu (Help))
)

FormatDoc: Menu
(
  Title ("Format Document")
  Item  ("Set Page Format",  Keys ([s-F7]))
  Item  ("Set Margins",      Keys ([s-F6] "3"))
  Item  ("Set Spacing",      Keys ([s-F6] "4"))
  Item  ("Go to Main Menu",  Menu (Main), Button (LBO))
)

FormatText: Menu
(
  Title ("Format Text")
  Item  ("Bold Text",        Keys ([F6]))
  Item  ("Underline",        Keys ([F8]))
  Item  ("Block Start/End",  Keys ([a-0]))
  Item  ("Center Text",      Keys ([F5]))
  Item  ("Flush Right",      Keys ([F7]))
  Item  ("Indent",           Keys ([F4]))
  Item  ("Page Break",       Keys ([c-Enter]))
  Item  ("Reveal Function",  Keys ([s-F2]))
  Item  ("Rewrite Screen",   Keys ([s-F1]))
  Item  ("Go to Main Menu",  Menu (Main), Button (LBO))
)

EditCommands: Menu
(
  Title ("Edit Commands")
  Item  ("Erase Word",        Keys ([Home][Backspace]))
  Item  ("Erase Rest of Line",Keys ([c-End]))
  Item  ("Erase Rest of Page",Keys ([c-PgDn]))
  Item  ("Forward Search",    Keys ([F2]))
  Item  ("Reverse Search",    Keys ([F1]))
  Item  ("Find and Replace",  Keys ([a-F2]))
  Item  ("Move Text",         Keys ([a-9]))
  Item  ("Go to Main Menu",   Menu (Main),Button (LBO))
)

Help: Menu
(
  Title ("Help")
  Item  ("Bold",              Keys ([s-F3] [F6]))
  Item  ("Center",            Keys ([s-F3] [F5]))
  Item  ("Flush Right",       Keys ([s-F3] [F7]))
  Item  ("Forward Search",    Keys ([s-F3] [F2]))
  Item  ("Indent",            Keys ([s-F3] [F4]))
  Item  ("Move Text",         Keys ([s-F3] [a-9]))
  Item  ("Print Modes",       Keys ([s-F3] [a-4]))

  Item  ("Block Start/End",   Keys ([s-F3] [a-0]))
  Item  ("Retrieve Text",     Keys ([s-F3] [a-7]))
  Item  ("Reverse Search",    Keys ([s-F3] [F1]))
  Item  ("Save Text",         Keys ([s-F3] [a-8]))
  Item  ("Find and Replace",  Keys ([s-F3] [a-F2]))
  Item  ("Set Margins",       Keys ([s-F3] [s-F6] "3"))
  Item  ("Set Spacing",       Keys ([s-F3] [s-F6] "4"))
  Item  ("Set Tabs",          Keys ([s-F3] [s-F6] "1"))
  Item  ("Set Page Format",   Keys ([s-F3] [s-F7]))
  Item  ("Subscript",         Keys ([s-F3] [a-2]))
  Item  ("Superscript",       Keys ([s-F3] [c-2]))
  Item  ("Underline",         Keys ([s-F3] [F8]))
)

Motion: Menu
(
  Title ("Motion Commands")
  Item  ("Top of Document",   Keys ([Home] [Home] [Up]))
  Item  ("End of Document",   Keys ([Home] [Home] [Down]))
  Item  ("Next Page",         Keys ([PgDn]))
  Item  ("Previous Page",     Keys ([PgUp]))
  Item  ("End of Line",       Keys ([Home] [Right]))
  Item  ("Start of Line",     Keys ([Home] [Left]))
)

FileCommands: Menu
(
  Title ("File Commands")
  Item  ("Retrieve Text",     Keys ([a-7]))
  Item  ("Save Text",         Keys ([a-8]))
  Item  ("Print Text",        Keys ([:-PrtSc]))
  Item  ("System Commands",   Keys ([a-3]))
  Item  ("Exit Word Perfect", Keys ([a-=]))
)

;
;       Mouse Definition
;
Mouse
(
        Left    (LBO)
        Middle  (MB)
        Right   (RB)
        Cursor  (Arrowkeys)
)
```

Listing 2 Trillian visuALL

```
SYSTEM
  MOUSE   =     SPORTSTER
  baud    =     1200
  comm    =     1

button
  select    =    command
  mark      =    enter
  execute   =    enter
  user      =    enter

Cursor
  speed     =    5
```

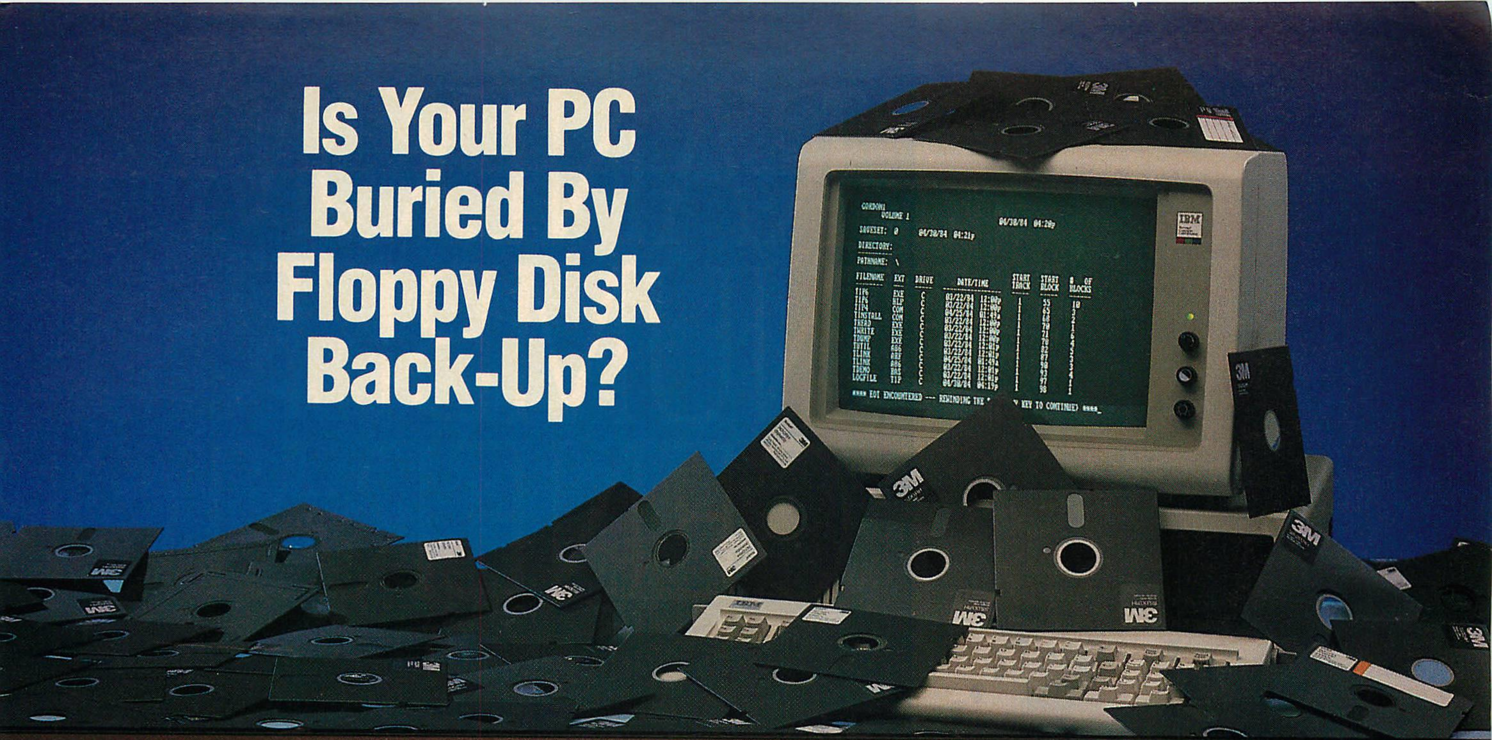
```
  right      =  if not (0-79 24 rightarrow) +
                   if (0-79 24 fly)
  left       =  if not (0-79 24 leftarrow) +
                   if (0-79 24 fly)
  up         =  if not (0-79 24 uparrow) +
                   if (0-79 24 fly)
  down       =  if not (0-79 24 downarrow) +
                   if (0-79 24 fly)

Keyboard
  select     =  noaction
  mark       =  noaction
  up         =  uparrow
  down       =  downarrow
  left       =  leftarrow
  right      =  rightarrow

SHELL  (wp.vsh)
window (WP Commands)
  File Commands      =  window (File Commands) command
  Format Document    =  window (Format Document) command
  Format Text        =  window (Format text) command
  Edit Commands      =  window (Edit Commands) command
  Motion Commands    =  window (Motion Commands) command
  Help               =  window (Help) command

window (File Commands)
  Retrieve Text      =  a-7 fprompt (Filename: ) enter
  Save Text          =  a-8 +
                        sprompt (Save to current file? ) +
                        response ('y') enter 'y' +
                        response not ('y') +
                        prompt (Filename: ) enter
  Print Text         =  c-Prtsc +
                        button (mark = if(0-18 24 '1' +
                        if(19-33 24 '2' +
                        if(34-54 24 '3' +
                        if (55-79 24 enter +
                        button (mark=enter)))))
  System Commands    =  a-3
  Exit Word Perfect  =  a-=
  Go to Main Menu    =  window (WP Commands) command

window (Format Document)
  Set Page Format    =  s-F7
  Set Margins        =  s-F6 '3' +
                        prompt (left margin: ) enter +
                        prompt (right margin: ) enter
  Set Spacing        =  s-F6 '4' +
                        prompt (set spacing to: ) enter
  Go to Main Menu    =  window (WP Commands) command

window (Format Text)
  Bold text          =  F6 button (mark = F6 +
                        button (mark = enter))
  Underline          =  F8 button (mark = F8 +
                        button (mark = enter))
  Range Edit         =  a-0 button (mark = a-0 +
                        button (mark = enter))
  Center text        =  F5
  Flush Right        =  F7
  Indent             =  F4
  Page Break         =  Linefeed
  Reveal Functions   =  s-F2
  Rewrite Screen     =  s-F1
  Go to Main Menu    =  window (WP commands) command

window (Edit Commands)
  Erase Word         =  Home Backspace
  Erase Rest of Line =  c-End
  Erase Rest of Page =  c-Pgdn +
                        prompt (Erase rest of page ? ) +
                        enter
  Forward Search     =  F2 prompt (Search string: )
  Reverse Search     =  F1 prompt (Search string: )
  Find and Replace   =  a-F2 prompt (Search string: ) +
                        prompt (Replace with: )
  Move Text          =  a-9
  Go to Main Menu    =  window (WP Commands) command

window (Motion Commands)
```

```
  Top of Document       =  Home Home Uparrow
  End of Document       =  Home Home Downarrow
  Next Page             =  Pgdn
  Previous Page         =  Pgup
  End of Line           =  Home Rightarrow
  Start of Line         =  Home Leftarrow
  Go to Main Menu       =  window (WP Commands) command

window (Help)
  Bold                  =  s-F3 F6
  Center                =  s-F3  F5
  Flush Right           =  s-F3  F7
  Forward Search        =  s-F3  F2
  Indent                =  s-F3  F4
  Move Text             =  s-F3  a-9
  Print Modes           =  s-F3  a-4
  Range on/off          =  s-F3  a-0
  Retrieve Text         =  s-F3  a-7
  Reverse Search        =  s-F3  F1
  Save Text             =  s-F3  a-8
  Search and Replace    =  s-F3  a-F2
  Set Margins           =  s-F3  s-F6 '3'
  Set Spacing           =  s-F3  s-F6 '4'
  Set Tabs              =  s-F3  s-F6 '1'
  Set Page Format       =  s-F3  s-F7
  Subscript             =  s-F3  a-2
  Superscript           =  s-F3  c-2
  Underline             =  s-F3  F8
  Go to Main Menu       =  window (WP Commands) command

end
```

Listing 3 Microsoft Mouse Menu

```
BEGIN EditMenu,MotionMenu,FileMenu,Left,Right,Up,Down,12,24

;------------------- Edit Menu -------------------------
EditMenu:  MENU    "Edit Menu",2,2,Normal
           OPTION  "Format Document",GotoFormatDoc
           OPTION  "Format Text",GotoFormatText
           OPTION  "Edit Commands",GotoEditCommands
           OPTION  "Help",HelpMenu
           OPTION  "Cancel"
           MEND

;------------------- Format Document Menu ---------------
FormatDoc: MENU    "Format Document",2,2,Normal
           OPTION  "Set Page Format",KeyShftF7
           OPTION  "Set Margins",SetMargins
           OPTION  "Set Spacing",SetSpacing
           OPTION  "Go to Edit Menu",GotoEditMenu
           OPTION  "Cancel"
           MEND

;------------------- Format Text Menu -------------------
FormatText: MENU    "Format Text",2,2,Normal
            OPTION  "Indent",KeyF4
            OPTION  "Bold Text",KeyF6
            OPTION  "Underline",KeyF8
            OPTION  "Block Start/End",KeyAlt0
            OPTION  "Center Text",KeyF5
            OPTION  "Flush Right",KeyF7
            OPTION  "Page Break",KeyCtrlEnter
            OPTION  "Reveal Functions",KeyShftF2
            OPTION  "Rewrite Screen",KeyShftF1
            OPTION  "Go to Edit Menu",GotoEditMenu
            OPTION  "Cancel"
            MEND

;------------------- Edit Commands Menu -----------------
EditCommands: MENU  "Edit Commands",2,2,Normal
            OPTION  "Erase Word",KeyHomeBacksp
            OPTION  "Erase Rest of Line",KeyCtrlEnd
            OPTION  "Erase Rest of Page",KeyCtrlPgDn
            OPTION  "Forward Search",KeyF2
            OPTION  "Reverse Search",KeyF1
            OPTION  "Find and Replace",KeyAltF2
            OPTION  "Move text",KeyAlt9
            OPTION  "Go to Edit Menu",GotoEditMenu
            OPTION  "Cancel"
            MEND
```

```
;-------------------- Help Menu ---------------------------
HelpMenu:   MENU    "Help is on the Way",1,2,Normal
            OPTION  "Cancel"
            OPTION  "Bold",HelpBold
            OPTION  "Center",HelpCenter
            OPTION  "Flush Right",HelpFlushRight
            OPTION  "Forward Search",HelpForwardSrch
            OPTION  "Indent",HelpIndent
            OPTION  "Move Text",HelpMoveText
            OPTION  "Print Modes",HelpPrintModes
            OPTION  "Block Start/End",HelpBlock
            OPTION  "Retrieve Text",HelpRetrieveText
            OPTION  "Reverse Search",HelpReverseSearch
            OPTION  "Save text",HelpSaveText
            OPTION  "FInd and Replace",HelpFindReplace
            OPTION  "Set Margins",HelpSetMargins
            OPTION  "Set Spacing",HelpSetSpacing
            OPTION  "Set Tabs",HelpSetTabs
            OPTION  "Set Page Format",HelpSetPageFormat
            OPTION  "Subscript",HelpSubscript
            OPTION  "Superscript",HelpSuperscript
            OPTION  "Underline",HelpUnderline
            MEND

;-------------------- Motion Menu -------------------------
MotionMenu: MENU    "Motion Commands",2,30,Bold
            OPTION  "Top of Document",KeyHomeHomeUp
            OPTION  "End of Document",KeyHomeHomeDown
            OPTION  "Next Page",KeyPgDn
            OPTION  "Previous Page",KeyPgUp
            OPTION  "End of Line",KeyHomeRight
            OPTION  "Start of Line",KeyHomeLeft
            OPTION  "Cancel"
            MEND

;-------------------- File Menu ---------------------------
FileMenu:   MENU    "File Commands",2,59,Inverse
            OPTION  "Retrieve Text",KeyAlt7
            OPTION  "Save Text",KeyAlt8
            OPTION  "Print Text",GotoPrintTextPopUp
            OPTION  "System Commands",KeyAlt3
            OPTION  "Exit Word Perfect",KeyAltEqual
            OPTION  "Cancel"
            MEND

;-------------------- Print Text Pop-Up -------------------
PrintTextPopUp: POPUP 23,2,Inverse
TEXT "╔═══════════════Print Menu════════════════╗"
TEXT "║Full Text Print; Page Print; Print Attrib; Cancel║"
TEXT "╚═════════════════════════════════════════╝"
             SELECT  2,2,16,FullTextPrint
             SELECT  2,19,11,PagePrint
             SELECT  2,31,13,SetPrintAttrib
             SELECT  2,45,6,CancelPrint
             PEND

FullTextPrint:  TYPE    "1"
PagePrint:      TYPE    "2"
SetPrintAttrib: TYPE    "3"
CancelPrint:    TYPE    "0"

;-------------------- Execute Statements ------------------
GotoEditMenu:        EXECUTE  LBEditMenu,EditMenu
LBEditMenu:          ASSIGN   EditMenu
GotoFormatDoc:       EXECUTE  LBFormatDoc,FormatDoc
LBFormatDoc:         ASSIGN   FormatDoc
GotoFormatText:      EXECUTE  LBFormatText,FormatText
LBFormatText:        ASSIGN   FormatText
GotoEditCommands:    EXECUTE  LBEditCommands,EditCommands
LBEditCommands:      ASSIGN   EditCommands
GotoPrintTextPopUp:  EXECUTE  KeyCtrlPrtSc,PrintTextPopUp

;-------------------- Help Statements ---------------------
HelpBold:            EXECUTE  KeyShftF3,KeyF6
HelpCenter:          EXECUTE  KeyShftF3,KeyF5
HelpFlushRight:      EXECUTE  KeyShftF3,KeyF7
HelpForwardSrch:     EXECUTE  KeyShftF3,KeyF2
HelpIndent:          EXECUTE  KeyShftF3,KeyF4
HelpMovetext:        EXECUTE  KeyShftF3,KeyAlt9
HelpPrintModes:      EXECUTE  KeyShftF3,KeyAlt4
HelpBlock:           EXECUTE  KeyShftF3,KeyAlt0
HelpRetrieveText:    EXECUTE  KeyShftF3,KeyAlt7
HelpReverseSearch:   EXECUTE  KeyShftF3,KeyF1
HelpSaveText:        EXECUTE  KeyShftF3,KeyAlt8
HelpFindReplace:     EXECUTE  KeyShftF3,KeyAltF2
HelpSetMargins:      EXECUTE  KeyShftF3,SetMargins
HelpSetSpacing:      EXECUTE  KeyShftF3,SetSpacing
HelpSetTabs:         EXECUTE  KeyShftF3,SetTabs
HelpSetPageFormat:   EXECUTE  KeyShftF3,KeyShftF7
HelpSubscript:       EXECUTE  KeyShftF3,KeyAlt2
HelpSuperscript:     EXECUTE  KeyShftF3,KeyCtrl2
HelpUnderline:       EXECUTE  KeyShftF3,KeyF8

;-------------- Key Assignments --------------------------
Left:             TYPE    0,75
Right:            TYPE    0,77
Up:               TYPE    0,72
Down:             TYPE    0,80

KeyAlt0:          TYPE    0,129
KeyAlt2:          TYPE    0,121
KeyAlt3:          TYPE    0,122
KeyAlt4:          TYPE    0,123
KeyAlt7:          TYPE    0,126
KeyAlt8:          TYPE    0,127
KeyAlt9:          TYPE    0,128
KeyAltEqual:      TYPE    0,131
KeyAltF2:         TYPE    0,105
KeyCtrl2:         TYPE    0,3
KeyCtrlEnd:       TYPE    0,117
KeyCtrlEnter:     TYPE    10
KeyCtrlPgDn:      TYPE    0,118
KeyCtrlPrtSc:     TYPE    0,114
KeyF1:            TYPE    0,59
KeyF2:            TYPE    0,60
KeyF4:            TYPE    0,62
KeyF5:            TYPE    0,63
KeyF6:            TYPE    0,64
KeyF7:            TYPE    0,65
KeyF8:            TYPE    0,66
KeyHomeBacksp:    TYPE    0,71,BACKSP
KeyHomeHomeUp:    TYPE    0,71,0,71,0,72
KeyHomeHomeDown:  TYPE    0,71,0,71,0,80
KeyHomeLeft:      TYPE    0,71,0,75
KeyHomeRight:     TYPE    0,71,0,77
KeyPgDn:          TYPE    0,81
KeyPgUp:          TYPE    0,73
KeyShftF1:        TYPE    0,84
KeyShftF2:        TYPE    0,85
KeyShftF3:        TYPE    0,86
KeyShftF7:        TYPE    0,90
SetMargins:       TYPE    0,89,"3"
SetSpacing:       TYPE    0,89,"4"
SetTabs:          TYPE    0,89,"1"
```



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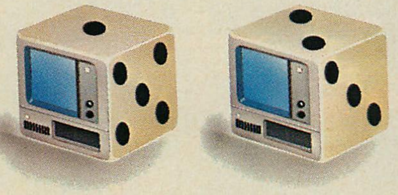


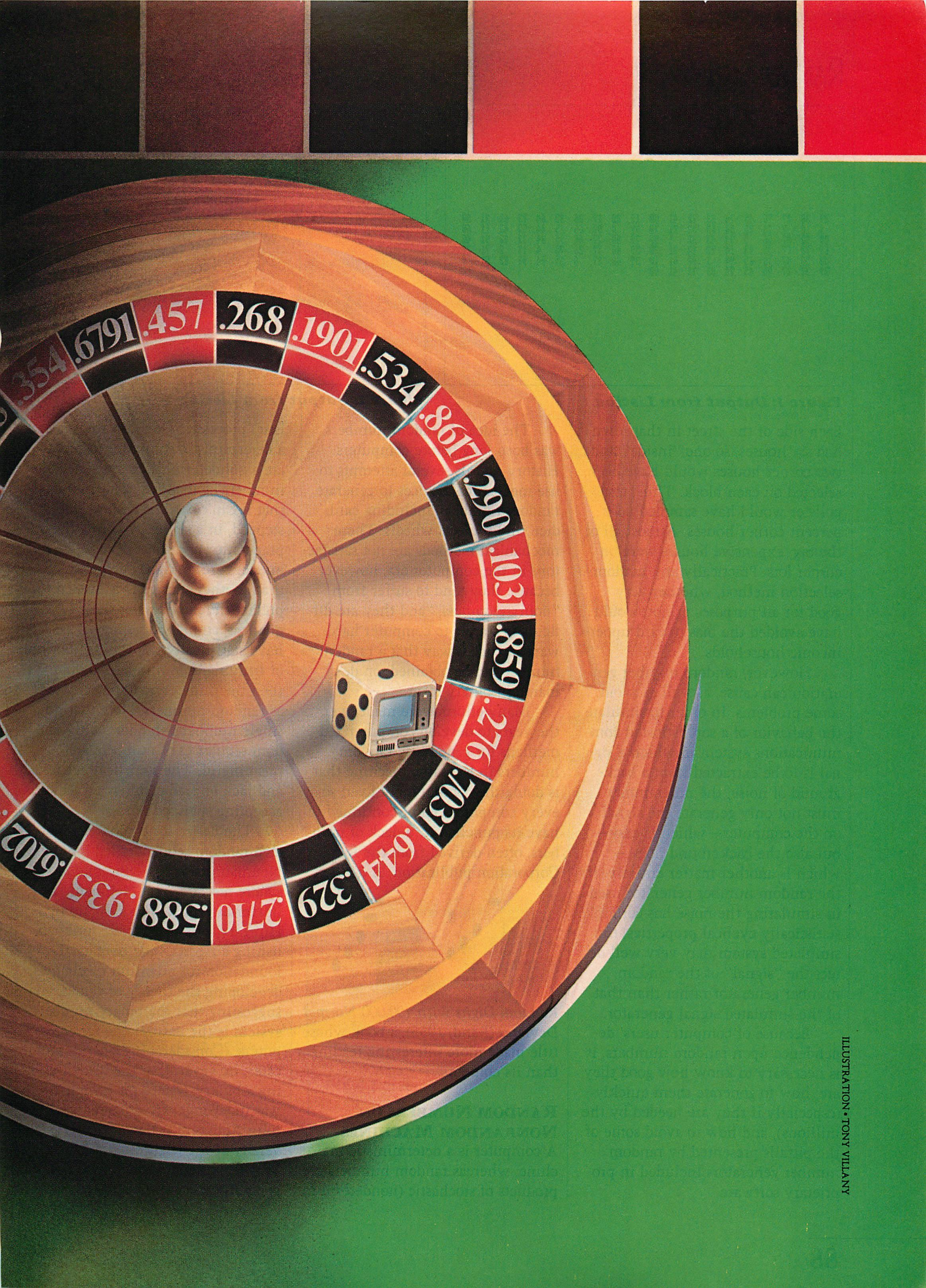
PAUL F. HULTQUIST

Spin the BASIC roulette wheel inside your PC

Random numbers are the lifeblood of certain kinds of computing. They introduce the vital element of chance in game programs. They are used to test statistical software. Simulation programs depend on random numbers to establish simulated situations. Auditors select files for reviewing with them. Pollsters use them to select participants for surveys.

Several years ago my household was chosen to participate in a marketing survey about some "serious" matter, such as the relationship of income to the kind of cereal consumed. Households were selected by starting with the house on the southwest corner of each block and polling every fifth house in a clockwise trip around the block. If that method had been used in my old hometown, it would have led to a serious bias in the survey results.

Paul F. Hultquist is a professor of electrical engineering and computer science at the University of Colorado at Denver. He has a Ph.D. in physics and has been teaching in the computer field for almost 30 years.



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29 38 27 96 45 74 83 72 41 90 19 28 17 86 35 64 73 62 31 80
 9 18  7 76 25 54 63 52 21 70 99  8 97 66 15 44 53 42 11 60
89 98 87 56  5 34 43 32  1 50 79 88 77 46 95 24 33 22 91 40
69 78 67 36 85 14 23 12 81 30 59 68 57 26 75  4 13  2 71 20
49 58 47 16 65 94  3 92 61 10 39 48 37  6 55 84 93 82 51  0
29 38 27 96 45 74 83 72 41 90
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Figure 1: Output from Listing 1

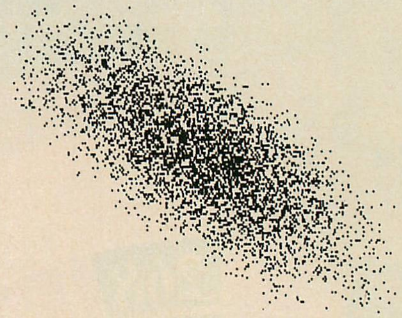


Figure 2: Output from Listing 2

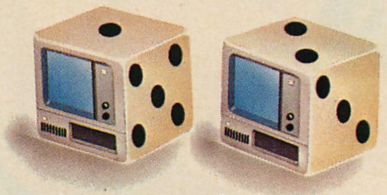
Each side of the street in that town had six houses, so one "inside" and two corner houses would have been selected on each block. Thus, the pollster would have sampled 66⅔ percent corner houses. Almost all of the big, expensive houses were on corner lots. Practically any random selection method, whether very good for all purposes or not, would have avoided the bias toward upper-income households.

However, random number generation can cause, as well as avoid, some problems. In order to simulate the behavior of a sophisticated communications system in which a signal is to be extracted from a background of noise, the programmer must not only generate the signal on the computer—which is easy—but also the background noise—which is another matter entirely. If the random number generator used in simulating the noise has certain statistically cyclical properties, the simulated system may very well detect the "signal" of the random number generator rather than that of the simulated signal generator.

Because of computer users' dependence upon random numbers, it is necessary to know how good they are, how to generate them quickly (especially if they are needed by the millions), and how to avoid some of the pitfalls presented by random number generators included in proprietary software.

The idea of random numbers was born long before computers. History reveals several attempts to use mechanical devices to generate random numbers, including cards, dice, and roulette wheels. These mechanical methods are not satisfactory in the computer era, however, because they tend to suffer from "nonrandomness," and they are difficult to couple to computer hardware in such a way that a random number can be obtained, on demand, in binary form.

Many efforts were made over the years to develop computerized methods for generating random numbers in the same machine that is doing the computation. Even so, every computer center continued to have its punched card deck of numbers, often derived from the Rand Corporation publication, *A Million*



Random Digits with 100,000 Normal Deviates (Rand, 1955), a book whose title made more interesting reading than its contents.

RANDOM NUMBERS ON NONRANDOM MACHINES

A computer is a deterministic machine, whereas random numbers are products of stochastic (nondeterministic) processes. How can the use of a deterministic computer to generate a nondeterministic sequence of numbers be justified? The answer is that it can't be. The issue is sidestepped, in a sense, by taking the pragmatic approach: if the sequences are so highly complicated that another computer is needed to predict the members of those sequences, and if the sequences behave statistically the way sequences of truly random numbers should, then the numbers will be accepted as random numbers. Note that no single number is random; only random *sequences* of numbers are meaningful. The statistical behavior and lack of predictability are keys to accepting such sequences.

The desire for computer-generated random sequences led John von Neumann to propose the *middle square method.* Von Neumann, a universal genius who grew up in Hungary, was responsible for establishing a rigorous mathematical foundation for quantum mechanics, developing the theory of games, and suggesting that the binary number system is the natural one for computers. (Considerable evidence indicates, however, that the idea of using a binary system for computers was independently proposed by John Atanasoff of Iowa State University at the beginning of World War II. His contribution was not generally recognized until recently.)

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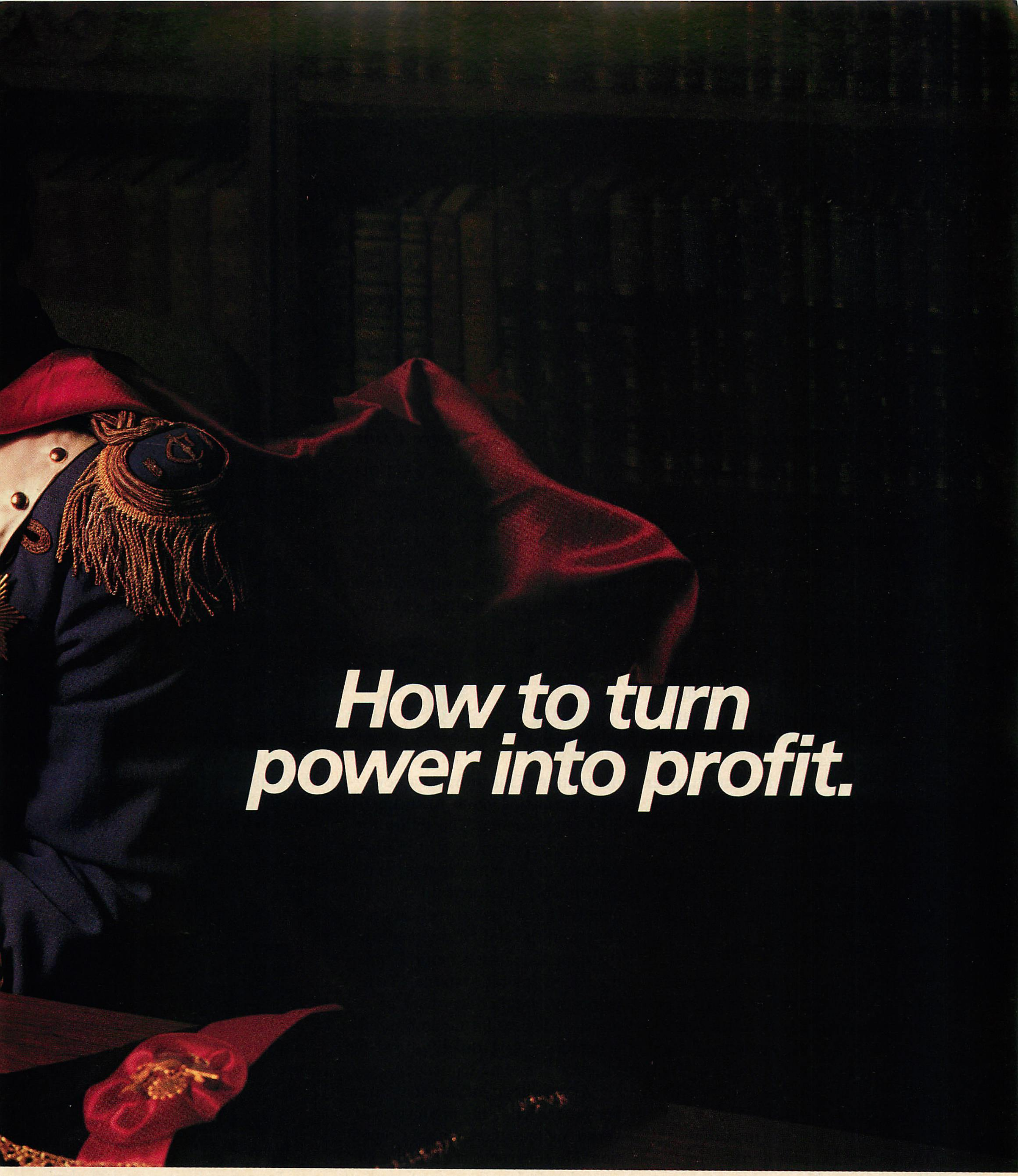

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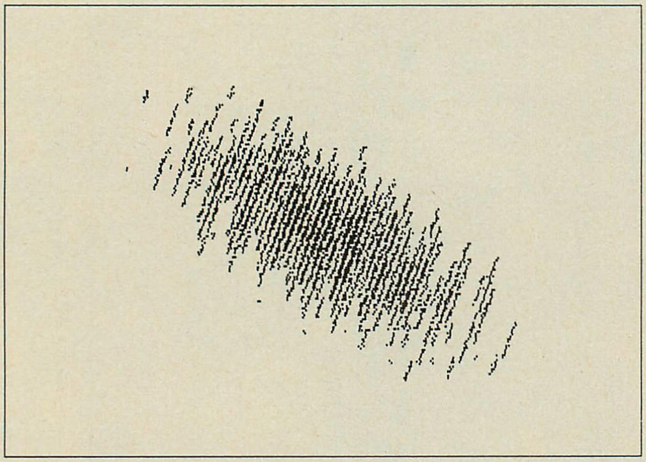

Figure 3: Output from Listing 3

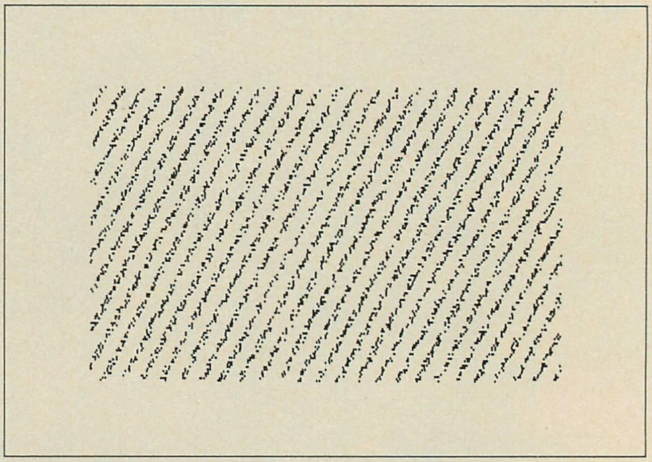

Figure 4: Output from Listing 4

Von Neumann's middle square process involved using the middle digits of successive squares in order to produce a random sequence. For example, if 9,268 is the nth number, then its square is 85,895,824, and the n+1st number is 8,958. Unfortunately, this method tends to fall into short cycles, the most pernicious of which is all zeros. Nonetheless, it helped in the early days of Los Alamos to solve, by simulation, problems that were intractable to classical mathematics.

Most of today's random number generators use some variation of the linear congruential method first proposed by Professor Derrick H. Lehmer of the University of California at Berkeley. His method can be expressed as an equation

$$x_{n+1} = ax_n + c \mod m$$

where x_n and x_{n+1} are the successive members in the sequence, a is the multiplier, c is an additive constant, and m is the modulus. For example, if $m = 101$, $c = 23$, $a = 21$, and $x_n = 38$, then $ax_n+c = 798$, which when divided by 101 is $7 + 91/101$. Because mod m means the remainder after division by m, then $x_{n+1} = 91$.

The IBM PC BASIC contains a random number generator RND that is of this type. According to Richard E. Farmer, manager of product support for Microsoft Corporation, the parameters for this generator are $a = 214{,}013$, $c = 2{,}531{,}011$, and $m = 2^{24}$. PC BASIC also contains an instruction RANDOMIZE. If included in a program, it calls for an integer between $-32{,}768$ and $+32{,}767$ that may be supplied from the keyboard or supplied with the

instruction. This provides a new seed, or starting value, to create a different sequence. The ability to reseed is important in that it allows the user to generate different and (presumably) independent sequences for statistical replication. However, the ability to reproduce the same sequence is helpful, during debugging for example. (That points out another drawback of physical devices for random number generation—it is usually impossible to repeat the same sequence.)

One difficulty in random number generation is the production of very long sequences without repetition. No congruential sequence can exceed m in length; as soon as all of the integers 0 through $m-1$ have been generated, it *must* repeat. Why should the user want all of the integers 0 through $m-1$? With a large value of m, he can generate enough numbers in the sequence to have many independent subsequences and thus can replicate his statistical experiments. In other words, the user can reseed the random number generator and use it many times without worry about duplication.

Another reason to produce all of the integers from 0 through $m-1$ is that if "chunks" of the region from 0 to $m-1$ were missing, the random number generator might not be uniform. Also, having all of the integers enables the user to know the length of the sequence of numbers before the generator begins to repeat itself.

It is known [Knuth, 1981] that the congruential generator can be made to cycle through all of the integers 0 through $m-1$ in some order if these conditions are met:

c must be relatively prime to m (the two cannot have any common divisors)

$a-1$ (sometimes called b) must be a multiple of every prime number that divides into m; if m is prime then b must be a multiple of m

If 4 divides m, then $a-1$ must be a multiple of 4.

For example, if $m = 100$, then c can be any prime number under 100, say, 29. Now $m=2^2*5^2$, so $b = a-1$ must contain 5 (second condition above) and 4 (second and third conditions) as factors. Thus, a suitable b is 20, and $a = 21$.

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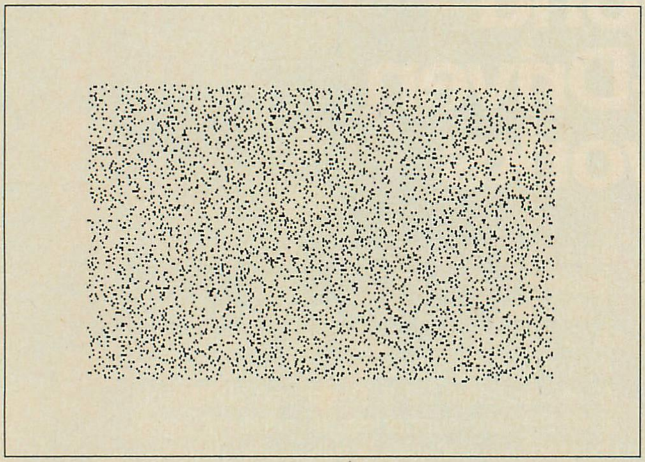


Figure 5: Output from Listing 5

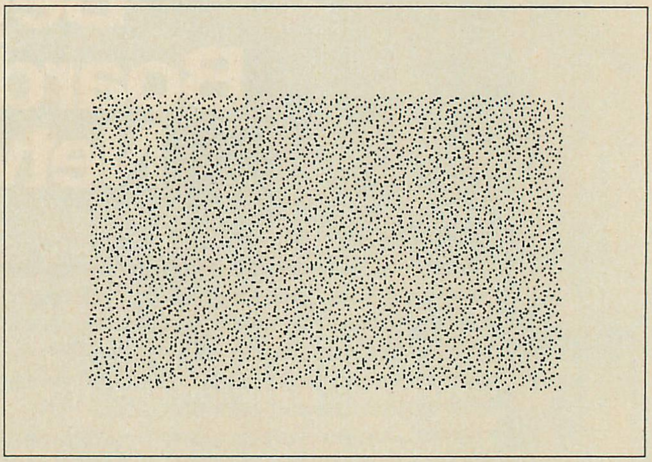
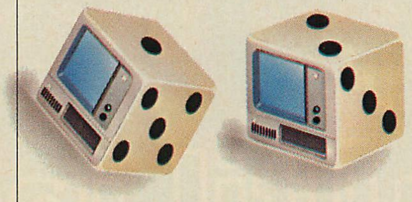


Figure 6: Output from Listing 6

The user now knows that $a = 21$, $m = 100$, and $c = 29$ will "go maximum cycle" or will generate every integer 0 through 99. Any integer (usually required in software to be less than m) will do as a seed, or starting value. For example, in this generator the sequence that is shown in figure 1 can be generated by starting with zero as the seed. The BASIC program to do this is shown in listing 1.

The sequence as generated doesn't look very random when displayed in this form (as shown in figure 1). If the user were presented with these numbers in sequential order (as read across the page), he would undoubtedly catch on immediately to the pattern of the unit's digits; it would probably take more time to see the pattern in the 10's digits. That is a characteristic of random number generators: the least significant digits are generally the least random.

Why does the IBM PC BASIC function RND give fractions? Most generators embedded in commercial software have several options for presenting results, even though the underlying process is one using integers. The most common way of presenting random numbers is in the form x_{n+1}/m. That is, the random integer is divided by the modulus and expressed in floating point form as a fraction in the range 0 to 1, but not including 1. Because the common methods generate fractions that are *uniformly distributed* between zero and 1, the mathematical notation $U[0,1)$ is sometimes used to indicate that the set of possible numbers include 0 but not 1.



The Urge for Speed

Programmers who use random numbers by the millions are concerned about the speed of generation. For this reason most generators are written in machine language and called as functions. Often, a desire to speed up the generation process leads to the omission of the addition of c. This creates a set of new problems, such as how to guarantee maximum cycle, which in the $c <> 0$ case was dependent on c not being zero.

If c is chosen as zero, then a must have much more severe restrictions. Since zero cannot be included in the cycle, the seed must be restricted to be non-zero and relatively prime to m. Furthermore, maximum cycle is always less than m; the best solution is to make m a prime number, in which case the cycle length is $m-1$ for proper a.

The urge for speed also suggests that the value of m be made the "word size" of the computer. Then, when $ax_{n+1} + c$ has been computed, whether c is zero or not, the mod m can be found simply by retaining the "remainder" (least significant) portion in the multiple length register used for multiplication. This is attractive because it eliminates the need for a division to carry out the modulus operation.

Those who wish to pursue the technicalities of the $c = 0$ case, plus the use of the word size for m, should read *Seminumerical Algorithms: The Art of Computer Programming* (Knuth, 1981). The mathematics and the arguments are difficult reading, but most PC users are not so pressed for speed that they need to use the more esoteric methods—if so, they should have been using the Cray or the Denelcor HEP from the beginning. Perhaps the $c <> 0$ version will serve as well as the faster versions, considering the speed of the PC.

RND Surprises

The toy random number generator discussed previously is obviously not enough for most users; it is far from random. Because IBM BASIC (and other high-level languages) do not support integers beyond the value 32,767, generating good congruential sequences using programs written in these languages is impossible. No values of m larger than 181 can be used in the linear congruential generator written in

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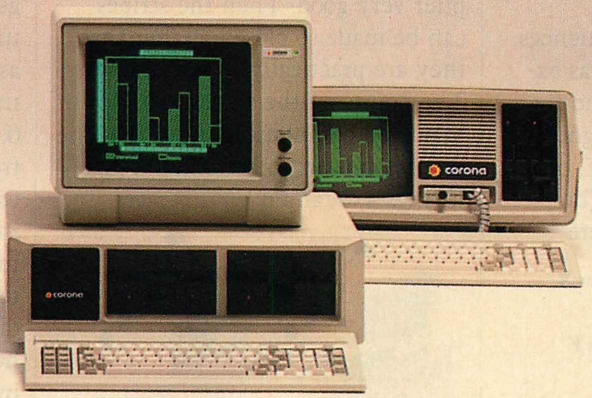

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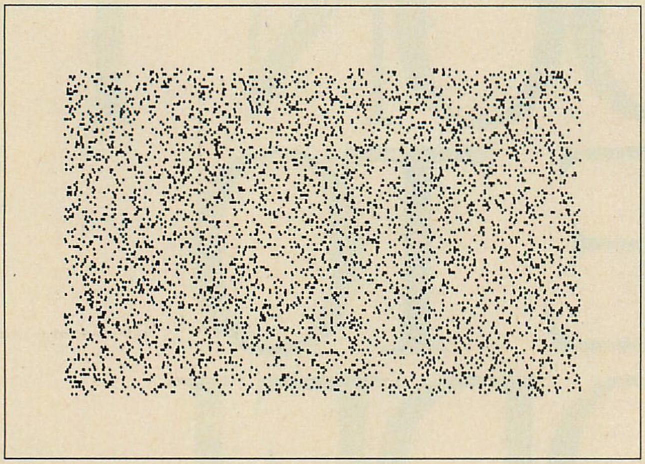

Figure 7: Output from Listing 8

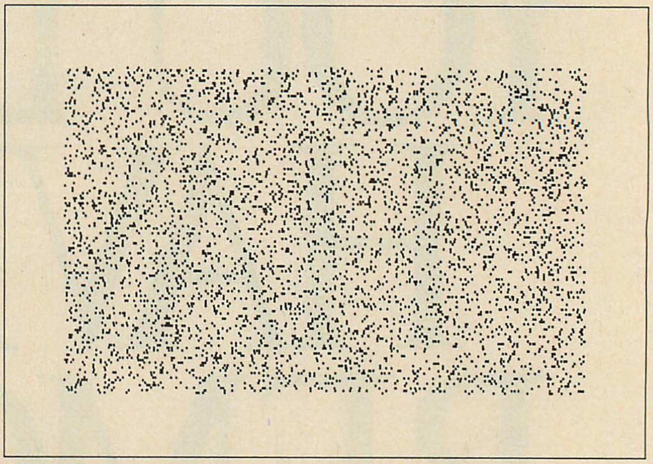

Figure 8: Output from Listing 9

BASIC because of integer overflow; therefore, sequences cannot exceed 181 in length.

This is totally unsatisfactory for most purposes, so the user may be forced to write a congruential generator in assembly language and couple it to the high-level language as a function. He may also use what has been provided in the language (which I started to do with RND) or one of the "randomizers" with RND to give better sequences.

Figure 2 shows what I was expecting to get using RND, and figure 3 shows what I actually got. See listings 2 and 3 for the BASIC programs to run these figures. The coordinates on the screen were

$$I = 100 + 425*(0.3*W + 0.4*X + 0.3*Y)$$
$$J = 25 + 150*(0.3*X + 0.4*Y + 0.3*Z)$$

where W, X, Y, and Z were found by making four calls to RND. The pattern is supposed to show how correlated random variables behave. (Statisticians please note that the display coordinates are upside-down; the correlation is really positive.)

My next attempt to understand what was going on led to figures 4 through 6, which were helpful in learning something about RND. In these diagrams, the coordinates of the points were determined by

$$I = 80 + 465*RND$$
$$J = 35 + 130*RND$$

The differences among the figures appear because, in the case of figure 5, there is a do-nothing call to RND between the calculations of *I* and *J*, and in figure 6, there are two such calls. The very pronounced stripes, particularly in figure 4, are characteristic of congruential generators. All congruential generators behave this way; the trick is to make the modulus very large and the multiplier very good. Then the stripes can be made so close together that they are practically unnoticeable. The points on the screen will occur in such a complicated order that the process appears to be random. (See listings 4, 5, and 6.)

PUTTING GENERATORS TO THE TEST

The crucial test for good multipliers is the spectral test, which is discussed in Donald Knuth's book, mentioned above. He gives a table of several multipliers, both good and bad, along with the findings from the application of the test. Programmers wishing to go to the trouble of writing an assembly language program should take time to investigate the multipliers. Unfortunately, without big-integer software some of the conclusive tests, such as the spectral test, cannot be run on the PC in a high-level language.

A more practical method to test sequences of random numbers (perhaps from a generator whose method is embedded in software) is to generate displays such as those shown in the accompanying figures. This is easy and enlightening.

Other tests are statistical. One that is often applied, but that few generators ever fail, is the test for uniformity of distribution. This test asks if there are as many random numbers in the interval from, say, 0.1 to 0.2 as there are in the interval from 0.8 to 0.9. The distribution test is usually applied in the following way: the user decides how many intervals he wants to be tested, for example, 101; then inside of a DO loop, or FOR–NEXT loop, he multiplies each random number by 101, truncates, and adds 1 to avoid a zero index; this number is used as the index to raise the count of occurences in an array of occurrence counts; the limit on the loop should be chosen so at least 5 counts (10 is better) will occur in each "bin." The BASIC program is shown in listing 7.

The calculated quantity CHSQ is called *chi square*. Note that if all of the bins had precisely 10 (the expected number in the statistical sense) then chi square would be zero. In real life, the counts in the bins typically would be 8, 11, 10,

13, 7, 12, 9, . . . , so that chi square has some nonzero value. If, however, the generator is very bad, so that counts are such numbers as 0, 15, 3, 25, 1, 2, 30, . . . , then the value of chi square will be large.

The values of chi square, based upon a theoretical consideration of true randomness, are tabulated and are available in many places [Abramowitz and Stegun, 1964; CRC Tables, various editions]. For this particular example the value of chi square should lie in the range of about 90 to 109 (the so-called 75 percent and 25 percent points; 75 percent of the time chi square should be greater than 90 and 25 percent of the time it should exceed 109). The number of degrees of freedom, needed to find the correct entry in the table, is 100. (Only 100 of the bins can have their contents assigned arbitrarily; the 101st bin must take what is left over.)

A single application of this (or any other) statistical test is not enough. The random number generator ought to be reseeded and tested over a number of sequences. The failure of the generator—indicated by chi square values that are too low or too high (below the 95 percent value, for example, or above the 5 percent value)—in isolated cases is generally not of concern. Forty repetitions of the test applied to RND yielded values of chi square that ranged from 87.8 (about 70 percent of the time chi square should exceed this value) to 113.6 (about 20 percent of the time chi square should exceed this value), indicating that one cannot reject the hypothesis that chi square is distributed uniformly with this set of data.

A somewhat more sensitive test for uniformity is the Kolmogorov-Smirnov test. It compares the shape of the statistical distribution function for the generator with what actually occurs and measures the maximum excursions from the ideal. These values are also tabulated. This test is explained in Knuth's *Seminumerical Algorithms* and in many statistics books.

One of the more critical tests is the so-called runs test. A run is a monotonic sequence of numbers in which each is larger (or smaller) than its predecessor. For example, in the sequence of digits 8,3,5,9,2,4,7,9 the set 3,5,9 is a run (up) as is 2,4,7,9. The first one is of length 3, and the latter one of length 4. The distribution of the lengths of the runs is sometimes an indicator of the quality of the generator; particularly, this distribution seems to show up too-small multipliers.

Knuth shows a very complicated method for determining the value of a variable he calls V, where V is chi-square distributed. The

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complexity of the method results from the fact that successive runs are not quite statistically independent. I have used this procedure on RND and found that the values of *V* seem to be satisfactory. There is a simpler test that involves dropping the variate (uniformly distributed random number) immediately following a run, which relieves the dependency problem. This version gave similar results.

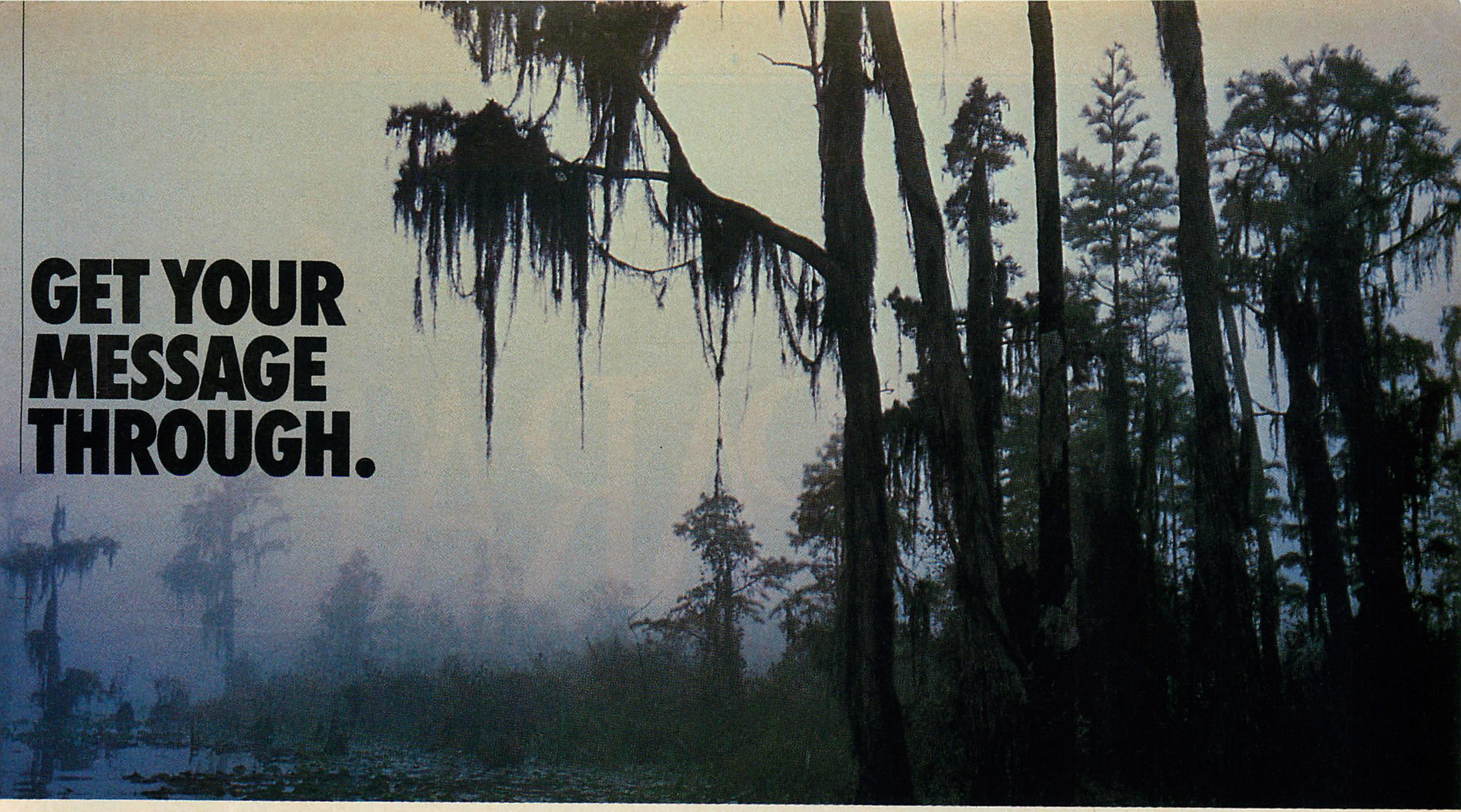
Other statistical tests include the poker-hand test (using random numbers to generate digits 0 through 9 in sets of, say, 5 digits and determining if there are appropriate proportions of two pairs, three of a kind, etc., in these sets), the coupon collector test (determining how long it takes to collect a full set of digits from 0 through 9, generated in sequence), and many others. Knuth describes and provides the relevant mathematics for most of the commonly applied tests.

In all such tests the user must remember that exceptional results can occur by chance. If a cardplayer were dealt 13 spades in a bridge hand, he would fall over dead of surprise, or at least be highly suspicious of the dealer. Nonetheless, such an event can happen with precisely the same probability that we are dealt any nondescript hand. Thus, an occasional bad result from a statistical test of a random number generator should be expected just as an occasional "fall-over-dead" hand in bridge should be expected. The judgment involved is how often to expect either. This is why more than one test is necessary. If the test shows up bad in the 5-percent sense significantly more than 5 percent of the time, then there is cause to worry.

ALTERNATIVES TO RND

Suppose that a user needs to use random numbers and has little else to use except RND in BASIC. RND does not appear to be the world's best random number generator. What does he do then? Is there any way out except to (a) punt, (b) write an assembly language generator with better properties, or (c) give up and go to a big machine at some service bureau and use an unknown generator that may be even worse?

Two schemes allow for the generation of more-random sequences from less-random ones. The first uses a vector of, say, 50 variates that have to be loaded into the vector at the beginning of use. One extra variate is kept as a spare. When a new random variate is needed by the program, the spare is used to calculate the "random index" of one of the cells of the vector; the contents of that cell are then used to replace the spare and are furnished to



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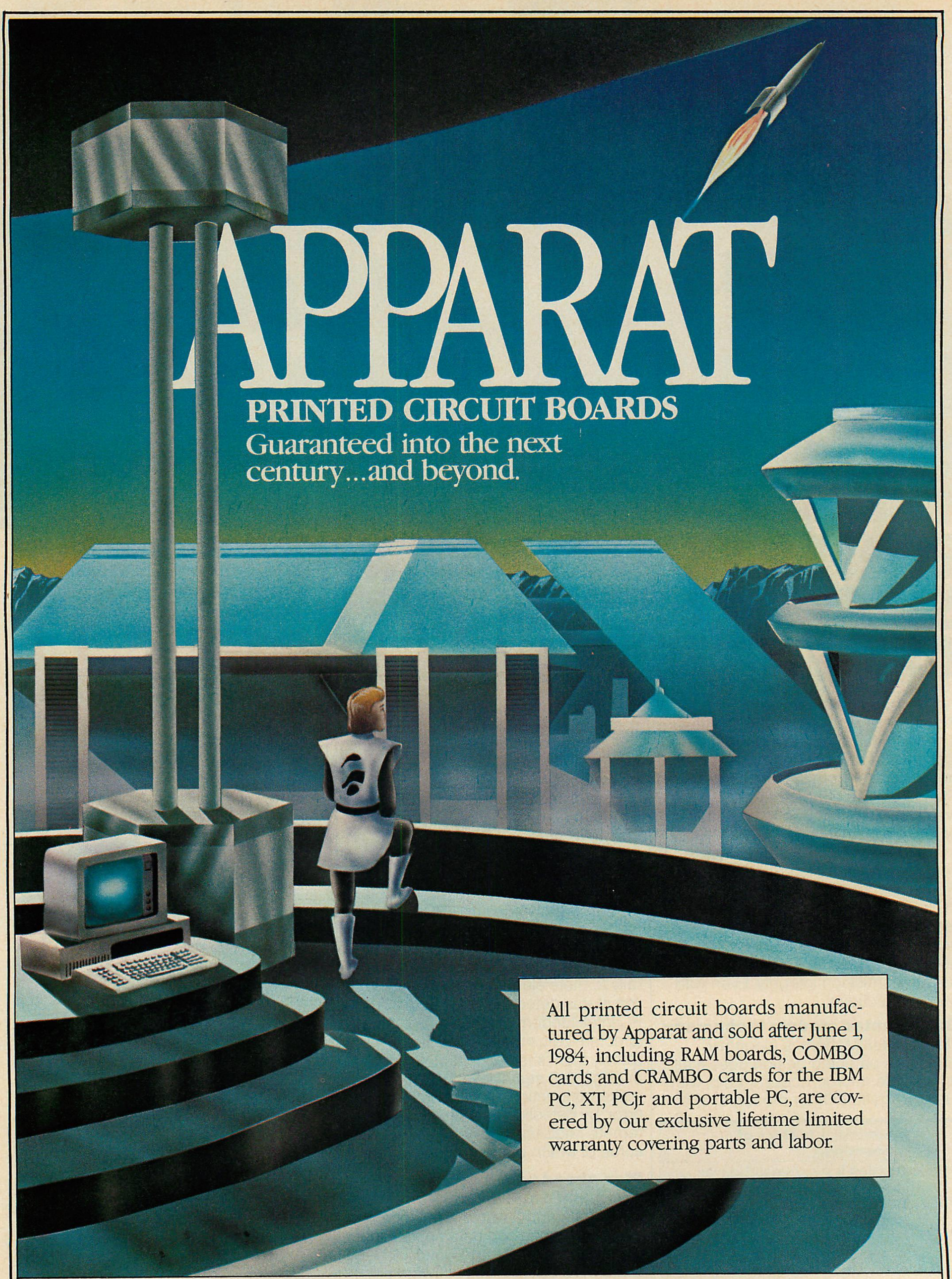
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the program. Next a call is made to RND to replace the contents of the cell. This method seems to provide sequences of random numbers that have good statistical properties in spite of the lack of randomness of the underlying generator. This procedure (lines 1100 through 1130, listing 2) was used to "clean up" figure 3 to get figure 2.

Execution time for producing these random sequences is somewhat longer than otherwise. Figure 7 shows the results of using this method to produce a diagram similar to those in figures 4 through 6. Reseeding this generator requires reseeding RND and then reloading the array. The BASIC code is given in listing 8.

The second method for generating more-random sequences from less-random ones needs another random number generator to get it started. It is called an additive generator because its method of generation relies on addition rather than multiplication. The equation for the nth random variate is given by

$$x_n = (x_{n-24} + x_{n-55}) \bmod m$$

where it is clear that $n > 55$. The choice of 24 and 55 for subscripts is not mere whimsy; these values guarantee that the period of the sequence will be very long, with a minimum period of $2^{55} - 1$, which is in excess of 3.6×10^{16}. If the modulus is less than this number the generator obviously must repeat some of the integers. The sequence will not repeat itself in fewer than this number of variates.

In this case, 16,384 can be used as the modulus because of the additive nature of the generator. At the beginning of the program, declare

```
DIM X (55)
DEFINT I,J,K,X
J = 24: K = 55
(RANDOMIZE)      'If desired
FOR I = 1 to 55
X(I) = INT (16384*RND)
NEXT I
```

To call for a number that is uniformly distributed on [0, 1), write

```
X(K) = (X(K) + X(J)) MOD 16384
U = X(K)/16384
J = J - 1 : K = K - 1
IF J=O THEN J = 55
IF K=O THEN K=55
```

The statements following *U = X(K)/16384* convert X into a circular buffer so that nothing but pointers need be moved as the program progresses. Reseeding the additive generator also requires reseeding RND and reloading the circular buffer with 55 new numbers.

A floating-point variation of this method was used to produce figure 8. In this version the array X is loaded directly from RND and thus avoids the integer operations entirely. Instead of

```
X(K) = (X(K) + X(J)) MOD 16384
U = X(K)/16384
```

write

```
X(K) = X(K) + X(J)
IF X(K) => 1.0 THEN X(K) =
  X(K) - 1.0
U = X(K)
```

This provides a little more speed than the integer version. Listing 9 is the program for this variation.

Is RND good enough? It probably would be satisfactory for taking a poll or running a game, but not for very sophisticated applications such as studies in communications theory or simulations in which successive calls to RND are expected to produce independent variates. For those purposes one of the randomizers described above would be better. The user could write his own generator in assembly language using a set of multiplier and modulus recommended by Knuth.

EDITOR'S NOTE

On a hunch, we compiled all of Professor Hultquist's programs using the IBM BASIC Compiler. We were surprised to learn that the BASIC Compiler's random number generator

does not exhibit the erratic symptoms found in the interpreted BASIC. In particular, programs 3 and 4 generated random patterns such as those in figures 2 and 5. Therefore, with or without Hultquist's adjustments to compensate for the inadequacies of interpreted BASIC's RND, compiled BASIC programs seem to generate random sequences.

Readers working with random numbers in BASIC, whether interpreted or compiled, are well-advised to entrust the generative algorithm carefully and build in one or more tests of randomness. **—JA**

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Listing 1 Multiplicative Congruential Method

```
10 '            'Toy random number generator
20 '              using multiplicative congruential method
30 '             - P. F. Hultquist, 1983
40 '
50 CLS : KEY OFF : X = 0      'Starting value
60 FOR I = 1 TO 110
70 X = (21*X + 29) MOD 100    'Generate 110 numbers so that we
80 PRINT USING "####"; X;     'can see the cycle begin to
90 NEXT I                     'repeat
100 LOCATE 10,35
110 PRINT "Figure 1"
120 END
```

Listing 2 Correlated Variable Display with Randomizer

```
10 '         Correlated variable display
20 '         showing problems with RND function
30 '         -by P. F. Hultquist, 1983
40 '
50 DIM ARRAY(50) : SCREEN 2 : CLS : KEY OFF
60 '         W,X,Y,Z are obtained from successive calls to RND
70 '         and then used to generate coordinates of display
80 '         points
85 GOSUB 1000
90 FOR K = 1 TO 5000
100 GOSUB 1100
101 W = V : GOSUB 1100
102 X = V : GOSUB 1100
103 Y = V : GOSUB 1100
104 Z = V
110 I = 100 + 425*(.3*W + .4*X + .3*Y)
120 J = 25 + 150*(.3*X + .4*Y + .3*Z)
130 PSET(I,J)
140 NEXT K
150 '        Print label for display
160 LINE (25,10)-(600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 2"
220 GOTO 2000
1000 '       Modification of random number generation
1010 '       to introduce "randomizer"
1020 FOR K = 1 TO 50
1030 ARRAY(K) = RND
1040 NEXT K
1050 '       This loads the array with random numbers
1060 '       to be used in the randomization
1070 SPARE = RND
1080 RETURN
1090 '       Enter here on succeeding calls
1100 KA = INT(SPARE*50) + 1          'generate random index
1110 SPARE = ARRAY(KA)               'replace spare
1120 V = SPARE : ARRAY(KA) = RND     'replace used number
1130 RETURN
2000 END
```

Listing 3 Correlated Variable Display without Randomizer

```
10 '         Correlated variable display
20 '         showing problems with RND function
30 '         -by P. F. Hultquist, 1983
40 '
50 SCREEN 2 : CLS : KEY OFF
60 '         W,X,Y,Z are obtained from successive calls to RND
70 '         and then used to generate coordinates of display
80 '         points
```


```
90 FOR K = 1 TO 5000
100 W=RND: X=RND: Y=RND: Z = RND
110 I = 100 + 425*(.3*W + .4*X + .3*Y)
120 J = 25 + 150*(.3*X + .4*Y + .3*Z)
130 PSET(I,J)
140 NEXT K
150 '          Print label for display
160 LINE (25,10)-(600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 3"
220 END
```

Listing 4 Using Successive Random Numbers Generated by RND

```
10 '            Random number generator demonstration
20 '            Coordinates of points in the display are
30 '            derived from using successive random
40 '            numbers generated by RND
50 '            -by P. F. Hultquist, 1983
60 '
70 SCREEN 2 : KEY OFF : CLS
80 FOR K = 1 TO 5000
90 I =  80 + 465*RND
100 J = 35 + 130*RND
110 PSET(I,J)
120 NEXT K
130 '
140 '           Arrange display
150 '
160 LINE (25,10) - (600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 4"
220 END
```

Listing 5 Using Successive Random Numbers with One Number Skipped

```
10 '            Random number generator demonstration
20 '            Coordinates of points in the display are
30 '            derived from using successive random
40 '            numbers generated by RND with one number
41 '            skipped between calculation of I and J
50 '            -by P. F. Hultquist, 1983
60 '
70 SCREEN 2 : KEY OFF : CLS
80 FOR K = 1 TO 5000
90 I =  80 + 465*RND
95 Z = RND
100 J = 35 + 130*RND
110 PSET(I,J)
120 NEXT K
130 '
140 '           Arrange display
150 '
160 LINE (25,10) - (600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 5"
220 END
```

Listing 6 Using Successive Random Numbers with Two Numbers Skipped

```
10 '          Random number generator demonstration
20 '          Coordinates of points in the display are
30 '          derived from using successive random
40 '          numbers generated by RND with two numbers
41 '          skipped between calculation of I and J
50 '          -by P. F. Hultquist, 1983
60 '
70 SCREEN 2 : KEY OFF : CLS
80 FOR K = 1 TO 5000
90 I =  80 + 465*RND
95 Z = RND : Z = RND
100 J = 35 + 130*RND
110 PSET(I,J)
120 NEXT K
130 '
140 '          Arrange display
150 '
160 LINE (25,10) - (600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 6"
220 END
```

Listing 7 Program to Compute Chi Square Test

```
10 '        Program to compute chi square test of uniformity
20 '        of distribution of RND random number generator
30 '        - P. F. Hultquist, 1983
40 DIM COUNT(101)     'Allows for 100 degrees of freedom
50 FOR I = 1 TO 101
60 COUNT(I) = 0       'Zero the count vector
70 NEXT I
80 RANDOMIZE
90 FOR I = 1 TO 1010
100 K = INT(101*RND) + 1   'Compute index of count
110 COUNT(K) = COUNT(K) + 1    'Count the occurrence
120 NEXT I
130 SUM = 0
140 FOR I = 1 TO 101              'Start computing chi square
150 SUM = SUM + (10 - COUNT(I))^2 '10 is the expected number in
160 NEXT I                        'each "bin"
170 CHSQ = SUM/10                 'Finish computing chi square
180 PRINT CHSQ
190 PRINT : PRINT "Another? (Y/N)";
200 A$ = INKEY$ : IF A$ = "" THEN 200
210 IF A$="Y" OR A$="y" THEN 50
220 END
```

Listing 8 Using Successive Random Numbers Generated by RND but Randomized

```
10 '          Random number generator demonstration
20 '          Coordinates of points in the display are
30 '          derived from using successive random
40 '          numbers generated by RND but randomized.
50 '          -by P. F. Hultquist, 1983
60 '
61 DIM ARRAY(50)
62 GOSUB 1000
70 SCREEN 2 : KEY OFF : CLS
80 FOR K = 1 TO 5000
85 GOSUB 2000
90 I =  80 + 465*V
95 GOSUB 2000
100 J = 35 + 130*V
110 PSET(I,J)
120 NEXT K
130 '
140 '          Arrange display
```

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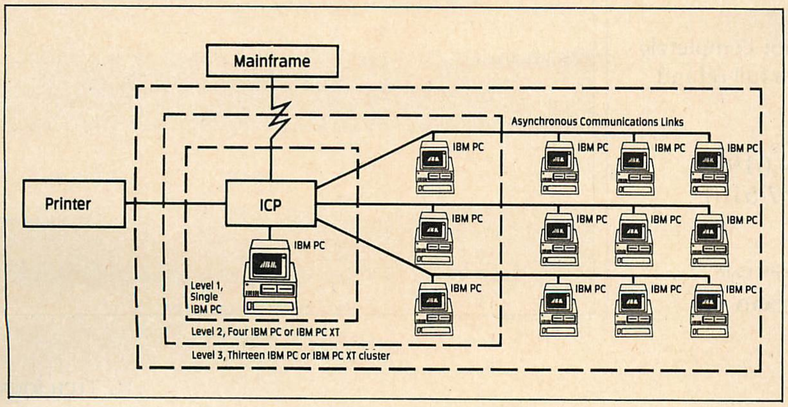

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```
150 '
160 LINE (25,10) - (600,10)
170 LINE -(600,190)
180 LINE -(25,190)
190 LINE -(25,10)
200 LOCATE 23,35
210 PRINT "Figure 7"
220 END
1000 FOR K = 1 TO 50    'Initialization of the
1010 ARRAY(K) = RND     'randomizer
1020 NEXT K
1030 SPARE = RND
1040 RETURN
2000 '           Randomizer
2010 KA = INT(50*SPARE) + 1
2020 SPARE = ARRAY(KA) : V = SPARE
2030 ARRAY(KA) = RND
2040 RETURN
```

Listing 9 Using Successive Random Numbers Generated by an Additive Generator

```
10 '           Random number generator demonstration
20 '           Coordinates of points in the display are
30 '           derived from using successive random
40 '           numbers generated by an additive generator
50 '           -by P. F. Hultquist, 1983
60 '
70 DIM ARRAY(55)
80 GOSUB 1000
90 SCREEN 2 : KEY OFF : CLS
100 FOR K = 1 TO 5000
110 GOSUB 2000
120 I = 80 + 465*V
130 GOSUB 2000
140 J = 35 + 130*V
150 PSET(I,J)
160 NEXT K
170 '
180 '           Arrange display
190 '
200 LINE (25,10)-(600,10)
210 LINE -(600,190)
220 LINE -(25,190)
230 LINE -(25,10)
240 LOCATE 23,35
250 PRINT "Figure 8"
260 END
1000 FOR K = 1 TO 55
1010 ARRAY(K) = RND
1020 NEXT K
1030 JA = 24 : KA = 55  'Initialize the pointers
1040 RETURN             'and return
2000                    'Randomizer
2010 SUM = ARRAY(JA) + ARRAY(KA)
2020 IF SUM>=1 THEN SUM = SUM - 1
2030 ARRAY(KA) = SUM
2040 JA = JA - 1 : KA = KA - 1  'Move the pointers
2050 IF JA=0 THEN JA = 55       'Manage the circular
2060 IF KA=0 THEN KA = 55       'buffer
2070 V = SUM
2080 RETURN
```

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TECH NOTEBOOK 22

Patchwork

Filling in the holes in DOS support for the undocumented SWITCHAR=- command

DANIEL M. FRANK

In the March issue of this magazine, there was a letter regarding the undocumented SWITCHAR feature of DOS 2.0 (see also Eric Roskos's article in this issue). This feature makes DOS easier to use, both for people accustomed to UNIX and for those who dislike the placement of the "\" key on the PC keyboard. Care should be taken when using this feature, however, for several reasons.

First, including this command in the CONFIG.SYS file does not make all programs automatically accept the right switch and path characters. Instead, each program must use a special undocumented DOS function to determine the current switch character; the program must then make its own judgment about the path character. The call that must be used is as follows:

```
MOV AX, 3700    ; Function 37,
  subfunction 0
INT 21H         ; Call DOS
```

This function returns the switch character in DL. (The character can be changed by putting the desired character in DL and setting AX to 3701 before making the call. Do not use any other values of AL—they have some obscure, undesirable effects on filename qualification.) All DOS utilities seem to make this call. However, some versions of the BASIC compiler will silently ignore critical switches.

The most critical hole in DOS support for SWITCHAR is that although the BACKUP command will use the appropriate path character in creating back-up diskettes, RESTORE does not do so when reading them. Thus, diskettes that are created by BACKUP with SWITCHAR=- will store pathnames in the headers using the "/" character, but RESTORE will look for "\"—and will not find it. All back-up diskettes that are created with SWITCHAR=- are effectively write-only disks. This is true under both DOS 2.0 and 2.1.

The solution to this problem is to use DEBUG to patch RESTORE so that it performs correctly with the alternate path character. Use this sequence (the computer's output is in boldface, and the user's responses are in regular type):

```
A> DEBUG RESTORE.COM
- A 69F
xxxx : 069F JMP 10A3
xxxx : 06A2
- A 10A3
xxxx : 10A3 CALL C16
xxxx : 10A6 MOV BL,[3F2]
xxxx : 10AA MOV [DC2],BL
xxxx : 10AE MOV [DDC],BL
xxxx : 10B2 MOV [DE7],BL
xxxx : 10B6 JMP 6A2
xxxx : 10B9
-RCX
CX 0FA3
: FB9
- W
- Q
A>
```

The CX register is used by DEBUG to determine how large the program is. Since this patch adds some code to the end, the number in CX must be increased before the program is written to the disk; otherwise the program will be lost. The new version of RESTORE should work properly with the alternate path character. Note, however, that diskettes must be saved and restored with the same path character in effect: to restore a diskette backed up without the SWITCHAR option, the user must remove the SWITCHAR statement from his CONFIG.SYS file and then reboot (or use function code 37/01 to change the switch character back to "/" temporarily).

The reliability of the BACKUP and RESTORE utilities has been questioned. Although none of my files has ever been mangled on restoration, I have had BACKUP fail to copy a file to diskette.

There is no obvious reason for these utilities to cause any problems, but there is something more subtle: the utilities do not handle file system errors. Once the transfer has begun, errors are ignored. If a file can't be opened, it is skipped. If it can't be read, it is truncated, sometimes to zero length.

File system backup is a crucial function for which error checking is essential. Perhaps a future DOS version will improve its support in this area.

Daniel M. Frank does program development and systems consulting on the PC. His current project involves transferring an application from DOS to QNX.

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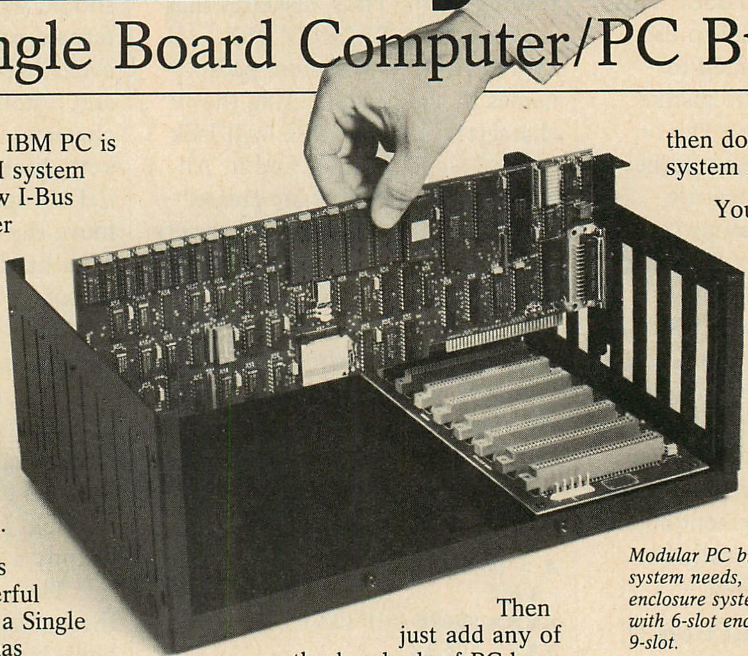

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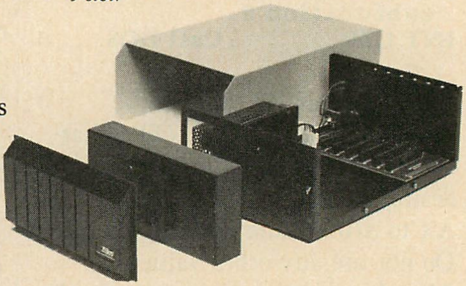

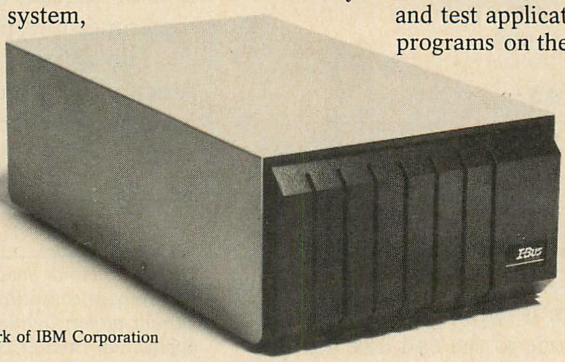

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CIRCLE NO. 277 ON READER SERVICE CARD

JACK WRIGHT

PC POWER-UP ERROR! CODES

An easy reference for use when the PC fails its diagnostics

Every time a PC is turned on, no matter which operating system is used or what disk is in the drive, the PC first cycles through a sequence of diagnostic tests contained in the BIOS ROM. The tests (except for the RAM test) are also done every time Ctrl-Alt-Del is pressed. If any of these tests fails, the result is an unusual sequence of beeps, a cryptic error code on the display, or both. What follows documents these error beeps and codes.

A failure of one or more of these tests can occur not only if a component in the PC fails but also if the system is reconfigured with a switch set incorrectly or if a defective expansion board is installed.

Table 1 presents the tests *in the order* in which they are performed. Thus, if you get one of these error messages, you will know that all the tests that are listed above that message in the table have been performed correctly. This can help in pinpointing the problem.

If you have the IBM Expansion Chassis, the messages above should always be interpreted as if you had a 256K system board. This is true because IBM supplies all Expansion Chassis customers with the 256K-system-board ROM.

You can customize the PC's response to the PARITY CHECK errors by writing your own interrupt 2 routine and having the AUTOEXEC.BAT file install it for use at boot-up. If the parity error always occurs immediately at boot-up, before the new interrupt 2 routine is installed, this of course will not work. But if your PC has ever suddenly shut down with a PARITY CHECK 1 or 2 error in the middle of a program, a custom interrupt 2 routine might allow you to remain up and possibly salvage much of your work, if the memory problem causing the parity error is not in a critical memory area used by DOS.

In emergency cases, parity checking can be disabled at any

Jack Wright works in the hardware and software development department of a large electronics firm in New Jersey.

time by sending 0 to I/O port AO. It can be turned back on by sending 80H to the same port. Some memory cards also have DIP switches that can be switched off to disable parity checking on that card. This can help to isolate the problem if you have more than one memory card. Generally, though, disabling parity checking is unwise. For example, think of the problems that could be caused if an undetected parity error occurred while the DISKCOPY command was in use.

It is interesting to note that these power-on diagnostic tests were put in the PC not just for the benefit of the end user in testing the PC every time it is turned on, but for several other important reasons as well. These tests give IBM an efficient method of burning in the PC on the assembly line, they assist technicians in repairing defective PCs, and they aid dealers in configuring PCs for the customer.

When a PC is manufactured, IBM sets it up to cycle through these tests (plus some other special diagnostic routines) repetitively for three hours during the assembly line burn-in; this weeds out most of the "infant-mortality" failures that can occur. Any error that does not allow the disk drive to function will make it impossible for a repairman to load any diagnostic programs from disk. When this occurs, the ROM test routines can be run and may help find the problem. Finally, if a dealer or customer improperly configures a machine, the tests will many times point out the problem.

Power-on diagnostic tests were put in the PC not just for the benefit of the end user in testing the PC every time it is turned on, but for several other important reasons.

Table 1: PC Diagnostic Tests

SYMPTOM	CAUSE
1. System does not respond at all when turned on	The power supply has shut down, OR: The 8088 has HALTed due to: – Internal 8088 problem – BIOS ROM checksum error – 8253 timer problem – 8237 DMA controller error – Error in 1st 16K of RAM NOTE: Try turning off power supply, waiting 5 secs., then turning it on.
2. System beeps: 1 long beep, 1 short beep, then stops (1 long beep=3 sec., 1 short beep=1 sec.)	The 8088 has HALTed due to: – 8259 interrupt controller error – 8253 timer counting too fast or slow
3. System beeps: 1 long beep, 1 short beep, but continues the power-up sequence	Checksum error in a BASIC ROM (64K system board only)
4. System beeps: 1 long beep, 2 short beeps, continues power-up sequence. See also 11 below.	Error in video RAM, or error in 6845 video circuitry
5. System beeps: 1 long beep, 2 short, 1 long, 2 short (64K system board only)	The display card is probably not installed.
6. '1801' appears at top of display	Error in the Expansion Unit Interface
7. 'XXYY 201' appears at the top of the display, where XXYY=four hexadecimal digits	RAM error. XX=the high order byte of the failing segment; e.g., XX=20 would indicate that the error occurred between segment 2000 and segment 2400. (Memory is tested in 16K blocks; each 64K increments the segment by 1000.) YY=the failing bit pattern, which can isolate the specific RAM.
8. 'XX 301' appears at the top of the display, where XX=two hexadecimal digits	Keyboard error. Usually a stuck key, where XX - the scan code of the stuck key.
9. '131' appears on display	Cassette port error
10. '1701' appears on the display	IBM Fixed Disk error
11. System beeps: 1 long beep, 2 short beeps, and 'ROM' appears on the display	Checksum error in a BASIC ROM (256K system board only)
12. '601' appears on display	Disk drive A: or disk adapter error
13. 'PARITY CHECK 1' appears	A RAM parity error has occurred on the system board. The INT 2 routine in the BIOS gains control and HALTs the 8088 when a memory parity error occurs. Parity checking had been DISABLED prior to this point in the test sequence, and is enabled here just before reading the boot record from the disk.
14. 'PARITY CHECK 2' appears on the display	A RAM parity error has occurred on an add-on memory board. This message comes from the BIOS ROM's INT 2 routine, which then HALTs the 8088.
15. 1 short beep	This is the normal system response just before the system boots from the disk.

ERROR CODES

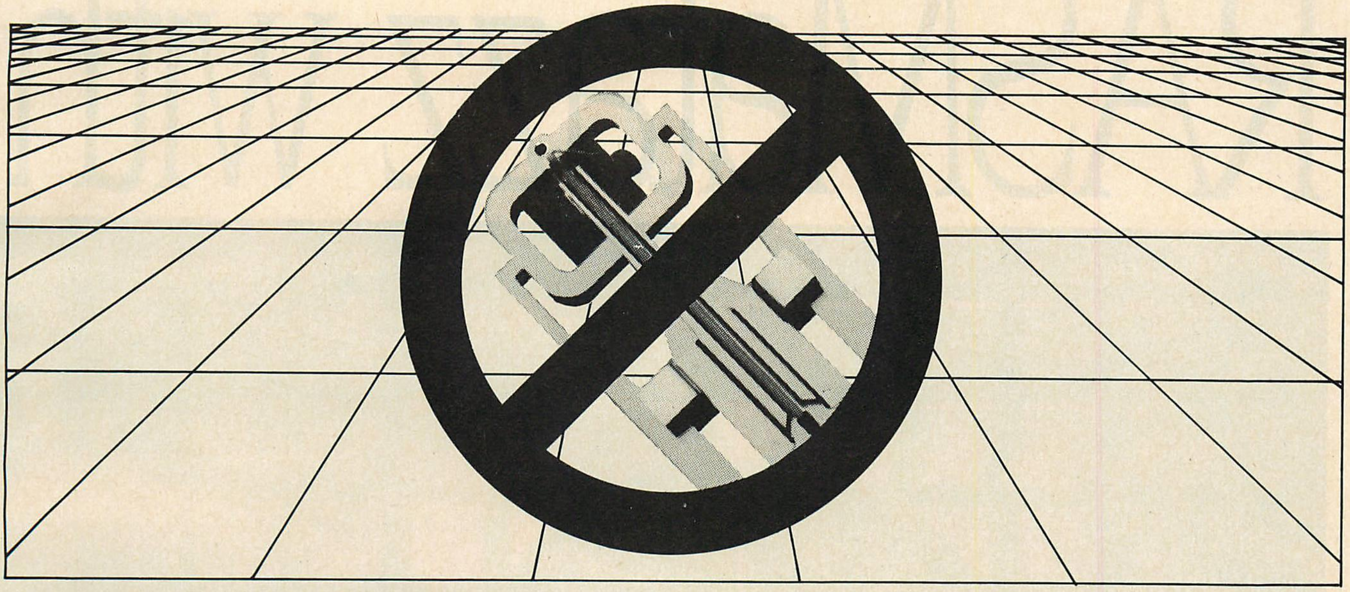
If you own a PC with a large memory, you know how time-consuming the RAM test can be and how rarely it finds a problem. If you do any machine language programming, you quickly begin to wish that the RAM test was not done *every* time the PC is turned on. Machine language programs in the debugging phase have a nasty habit of hanging up and responding only to the big red switch. IBM provides no way to skip the RAM test on power-up, nor is there any easy software fix, but Security Microsystems (16 Flagg Place, Staten Island, NY 10304, 212-667-1019) sells a BIOS ROM overlay called QUICKON ($69.95). This module forces

If you do any machine language programming, you quickly begin to wish that the RAM test was not done every *time the PC is turned on.*

the PC to skip the RAM test, allowing boot-up in only three seconds. An external switch can be connected to QUICKON to allow re-enabling of the RAM tests when desired.

Skipping the RAM test is not really risky, since the hardware parity checking present in all PCs provides a constant check on RAM data security. It does this by halting the PC with a "PARITY CHECK" message whenever a memory parity error occurs. This happens whenever an odd number of data bits change in a byte between the time it is written and the time it is read. Since RAM consists of 64K x 1 chips, a single failing chip can cause only a 1-bit error, thus triggering a parity error and forcing a type 2 interrupt (see also the references to the type 2 interrupt above).

No Head is Better than One!



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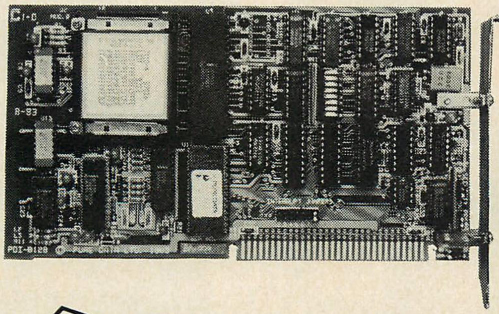

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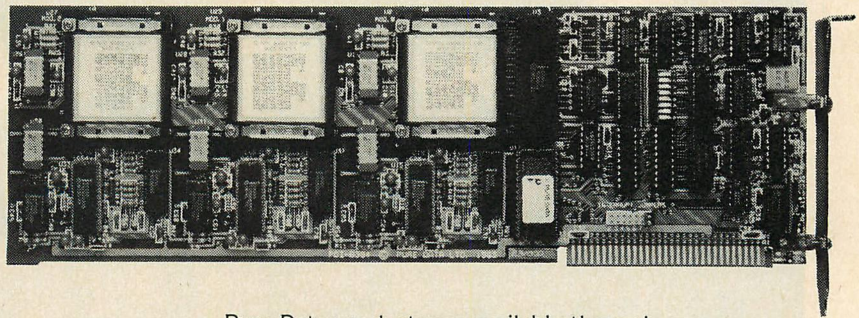

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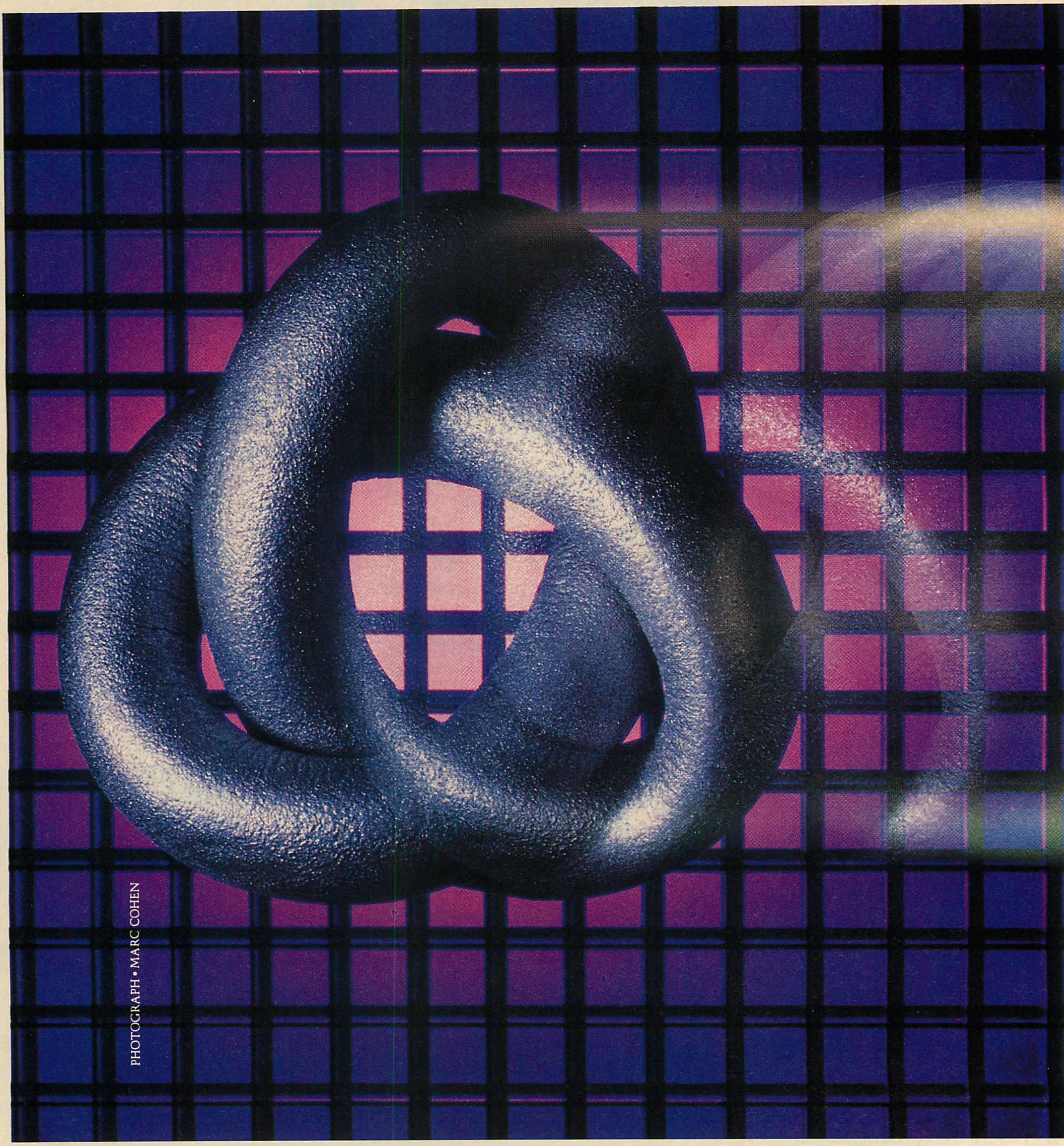
CIRCLE NO. 190 ON READER SERVICE CARD

Chris Dunford

RASMatazz with



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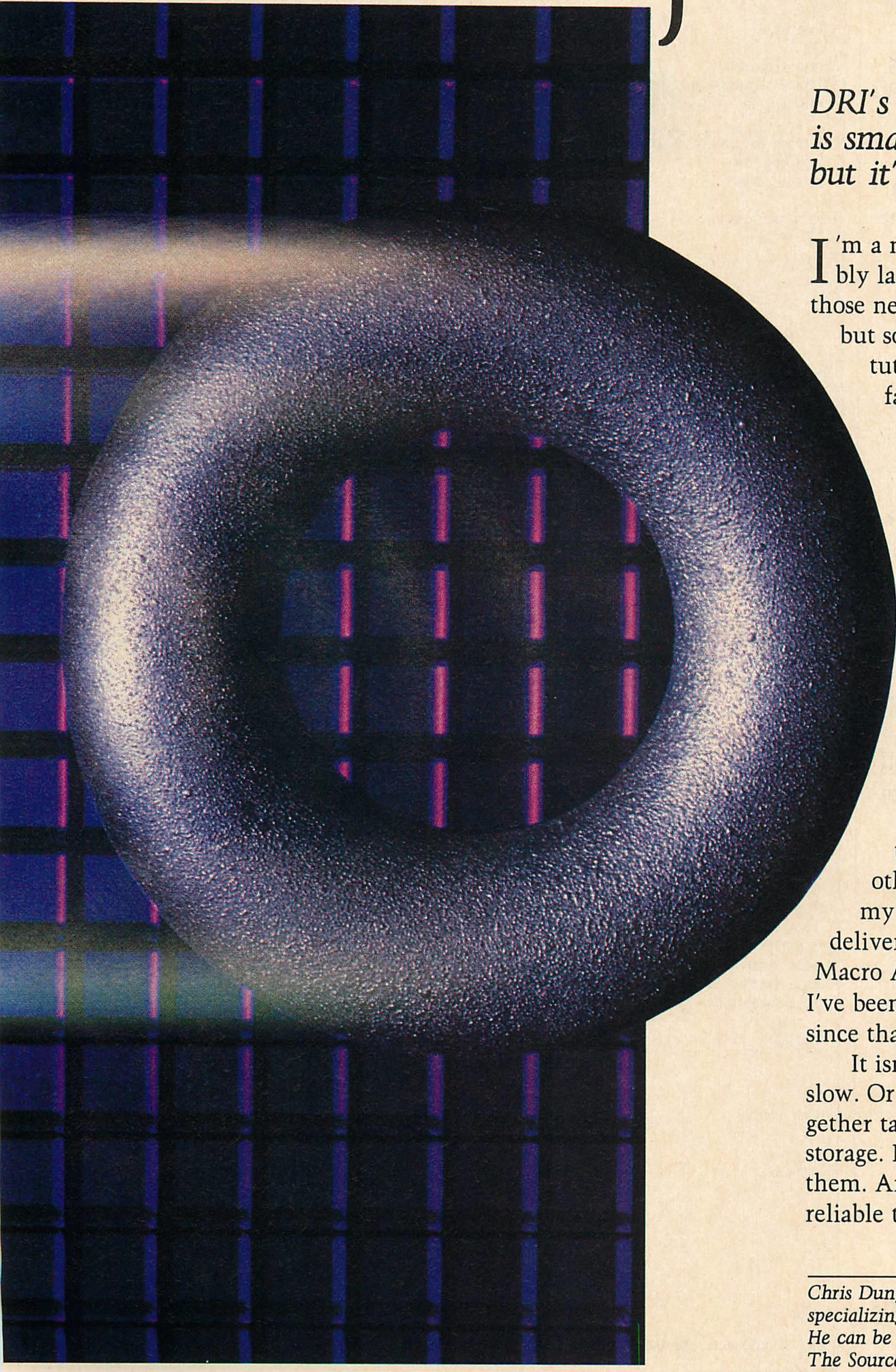

DRI's new PC-DOS assembler is smaller and faster, but it's lacking in amenities

I'm a member of a dying breed—assembly language programmers. I like all those new-fangled structured languages, but sometimes there's just no substitute for assembly language, that old-fashioned Pepperidge Farm of computer languages. No artificial ingredients. Back to basics. Pascal, C, LISP, Logo, Forth, APL, and all the rest simply can't match assembly language's speed, compactness, and intimacy with the hardware. High-level programming is a genteel occupation; assembly language programming is standing toe-to-toe with the machine in a battle for supremacy.

I told my computer dealer that I didn't care about the other software I had ordered for my new PC, as long as it was delivered with PC-DOS and IBM's Macro Assembler (MASM). And I've been struggling with MASM ever since that first day.

It isn't just that MASM is glacially slow. Or that the assembler and linker together take up almost 110K of scarce disk storage. No, there are bugs, too. Lots of them. Arithmetic calculations are so unreliable that many programmers compute

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constants at run time rather than during assembly. Macro expansions fail inexplicably. MASM goes west at the slightest provocation (try assembling the statement DSEG SEGMENT 'DATA' without the terminating apostrophe), requiring a machine reboot. Also, decimal real constants assemble incorrectly.

When an alternative to MASM was introduced I got pretty excited. The name was enticing—RASM-86. It sounded enough like Intel's ASM-86 to conjure up visions of a clone of that excellent assembler. And RASM-86 had good parentage: Digital Research, Inc. (DRI), the breeder of CP/M in all its incarnations. Early word was that RASM was fast, small, and virtually bug-free. I rushed to obtain this new product.

RASM-86 is, indeed, smaller and close to error-free. And it is somewhat faster than MASM, but not so much faster that I'd be willing to overlook its shortcomings. RASM-86 turns out to be the Volkswagen of assemblers. It's simple and functional, but lacking in amenities. Many of MASM's special features are absent in RASM-86.

Whether a programmer will find Digital's new assembler to be worthwhile depends on what he wants from his assembler. For small assembly language programs or compiled language subroutines, RASM-86 may be just the ticket. For writing large, complex, segmented programs, however, IBM's MASM is still the only choice.

What follows is a comparison of the two assemblers, with an emphasis on how RASM-86 differs from MASM. Most IBM assembly language programmers are reasonably familiar with MASM, which was written by Microsoft and released by IBM as Version 1.0. Microsoft, however, has now released an updated version (1.25) under its own logo. The new version is somewhat faster and supports the 8087 math chip. It also has its own brand-new set of bugs.

Figure 1: *RASM-86 Language Samples*

```
                          ; ===========================================================
                          ; RASM-86 sample listing.  This is NOT an executable program!
                          ; ===========================================================
                          dseg
0000                      Buffer  rb      2000H          ; Reserve byte storage: DB 2000H DUP (?)

2000 010002000300         Table   dw      1,2,3,4,5      ; Define a little table
     04000500
200A 05                           db      length Table   ; # items in Table
200B 04                           db      last Table     ; Index of last item in table
200C 02                           db      type Table     ; 1=byte, 2=word, 4=dword
200D 0820          R              dw      offset Table + (last Table * type Table) ; Ptr to last item

200F 0102030405           BigTable db     1,2,3,4,5      ; Define a "big" table
2014 060708090A                   db      6,7,8,9,10     ; This screws up the LENGTH operator...
2019 05                           db      length BigTable ; ...which only knows about the first 5 items

** ERROR NO: 20   ILLEGAL EXPRESSION ELEMENT
201A 00000000             LongInt dd      123456         ; Illegal, DD operand must be an address
201E 1C000000             Pointer dd      ShortLabel     ; This one is OK

2022 6821A29A901C         SomeNumber dw   2168H,9AA2H,1C90H,3FFEH ; Define a 64-bit number for 8087...
     FE3F
                                                         ; ...no hex reals or decimal scientific allowed

                          ; -------------------------------------------------------------
                          ; Define an ES segment. Note no ENDS statement necessary for DSEG.
                          ; Here, we override RASM's assumptions on name, type, and alignment.
                          ; -------------------------------------------------------------
                          XtraSeg eseg public byte
** ERROR NO: 10 **  NEAR: "?"   UNDEFINED ELEMENT OF EXPRESSION
0000 0000                 xxvar1  dw      ?              ; Oops, no ? initializer
                                                         ; Note error msg tells where error is
0002 0000                 xxvar2  dw      0

                          ; -------------------------------------------------------------
                          ; Define a code seg. RASM assume name CODE, type PUBLIC, align BYTE.
                          ; Group CODE and CODE1.  Note lack of ASSUME statements.
                          ; -------------------------------------------------------------
                          cgroup group code, xxcode
                          cseg
                          main:                          ; No PROC statements!
0000 B80000        R              mov ax,data            ; Assumed name of data segment
0003 8ED8                         mov ds,ax
0005 A11000                       mov ax, .10H           ; Equiv to MOV AX,DS:[10]
** ERROR NO:  7   OPERAND(S) MISMATCH INSTRUCTION
0008 909090909090                 lea ax,main            ; Don't know what's wrong with this

000E B80000        E              mov ax,XtraSeg         ; Point to XTRASEG...
0011 8ED8                         mov ds,ax              ; ...in DS segreg
0013 26A10200      R              mov ax,xxvar2          ; Note unnecessary ES: override generated
0017 A10200        R              mov ax,ds:xxvar2       ; This is the only way to get rid of it
001A EB00            001C         jmps ShortLabel        ; Replaces JMP SHORT

                          Short$Label:                   ; $ not significant in symbols
001C 9BDCC8                       fmul st0,st0           ; 8087 supported...
001F 9BDC062220    R              fadd64 SomeNumber      ; ...with some nonstandard mnemonics

** ERROR NO:  7   OPERAND(S) MISMATCH INSTRUCTION
0024 909090909090                 mov ax,cgroup          ; Group name not a label, bad operand
** ERROR NO: 22   LABEL OUT OF RANGE
002A E8D3FF          0000         call Subrt             ; Unsuccessful, even though GROUPed...
002D 9A00000000    R              callf Subrt            ; ...must use unnecessary far call
0032 EA00000000    R              jmpf Subrt             ; ...or far jump

  00C8                    DosVer equ 200
                          IF DosVer EQ 110               ; IF tests zero/nonzero result of expression
                                  mov ax,1               ; So this doesn't get assembled...
                          ELSE
0037 B80200                       mov ax,2               ; ...but this does
                          ENDIF

003A CB                           retf                   ; Far RET to DOS (if this was a real program)

                          ; -------------------------------------------------------------
                          ; Define a second code seg to be GROUPed with the first. Note that
                          ; RASM requires FAR jumps and calls between GROUPed segments.
                          ; -------------------------------------------------------------
                          xxcode cseg
                          Subrt:
0000 CB                           retf                   ; Have to use RETF to match the CALLF
                          end
END OF ASSEMBLY.  NUMBER OF ERRORS:   5.  USE FACTOR:  0%
```

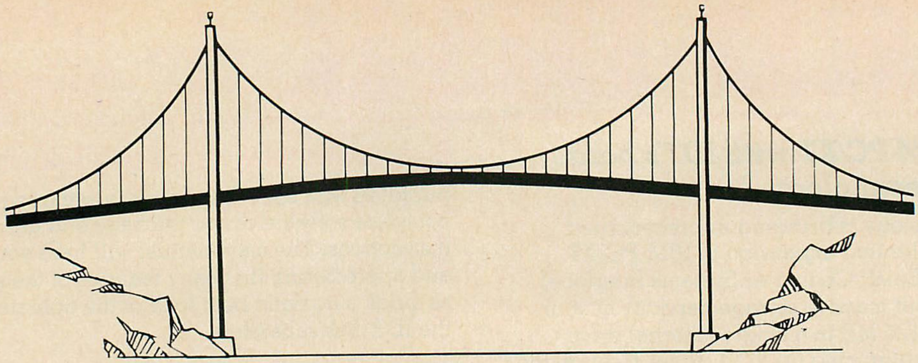


Figure 1 contains samples of various facets of RASM-86. The "program" itself does nothing in particular—its only purpose is to illustrate RASM's syntax.

RASM-86: WHAT AND WHY

RASM-86 is a relocating assembler that runs under PC-DOS. It is packaged with its own linker, LINK-86 (along with several other utilities that will be discussed later). A relatively simple assembler, RASM-86 lacks many of the bells and whistles of IBM's MASM. As a result, it seems to be inadequate for the development of large, stand-alone programs. It could more reasonably be used for smaller, self-contained utilities or for the production of assembly language subroutines for high-level language programs.

Yet there are problems here, too. RASM-86 object modules may be slightly different from Microsoft/IBM object modules; thus, RASM theoretically should not be used to produce modules for any compiler that uses the Microsoft/IBM linker—which knocks out most PC-DOS compilers on the market today. (Note, however, that many RASM object modules actually will work with the IBM linker—more on this later.)

So the question is this: why RASM? Why did DRI, the CP/M king, release a rather modest assembler that runs under PC-DOS?

According to DRI, RASM-86 is intended both as a stand-alone assembler and as a tool to produce subroutines for its DOS compiled languages. DRI has already ported its C, PL/I, and CBASIC compilers from CP/M to DOS; FORTRAN is next. RASM-86 is a virtual clone of DRI's (not Intel's) ASM-86, which is the CP/M-86 assembler. RASM should therefore simplify the task of porting subroutines written for the CP/M versions of Digital's languages. Pascal MT+, however, has its own assembler and is not compatible with RASM.

RASM-86 is part of DRI's Assembler Plus Tools package; the other parts are a linker (LINK-86), a cross-referencer (XREF-86), an object module librarian (LIB-86), and a symbolic debugger (SID-86). (Significantly, all five programs are distributed on a single 160K diskette, with 25K to spare.)

The nicely packaged documentation is not intended for beginners; there are many complex statements, such as "The PTR operator creates a virtual variable or label valid only during the execution of the instruction." The assembler section is terse (the SID-86 debugger section of the manual is longer, although SID is a much simpler program) and could use more examples.

Unlike IBM's MASM documentation, RASM's contains little information on 8086/88 operations. This manual describes how to use the assembler, not how to program the CPU. The manual is generally accurate, although I found a few operations that (according to the RASM documentation) should have worked but did not. It's hard to say whether these anomalies were the result of minor bugs in the software or whether they resulted from errors in the documentation.

RASM-86 occupies about 39K on disk, compared to MASM's 68K. The rest of the programs in the package are comparable in size to their IBM equivalents (see table 1 on page 130).

Invoking the Assemblers

RASM-86 is strictly command-driven. All parameters must be entered via the command line. The parameters include the mandatory source file name and five options, each consisting of a one-character specifier followed by a one-character argument. Options may be in any order on the command line.

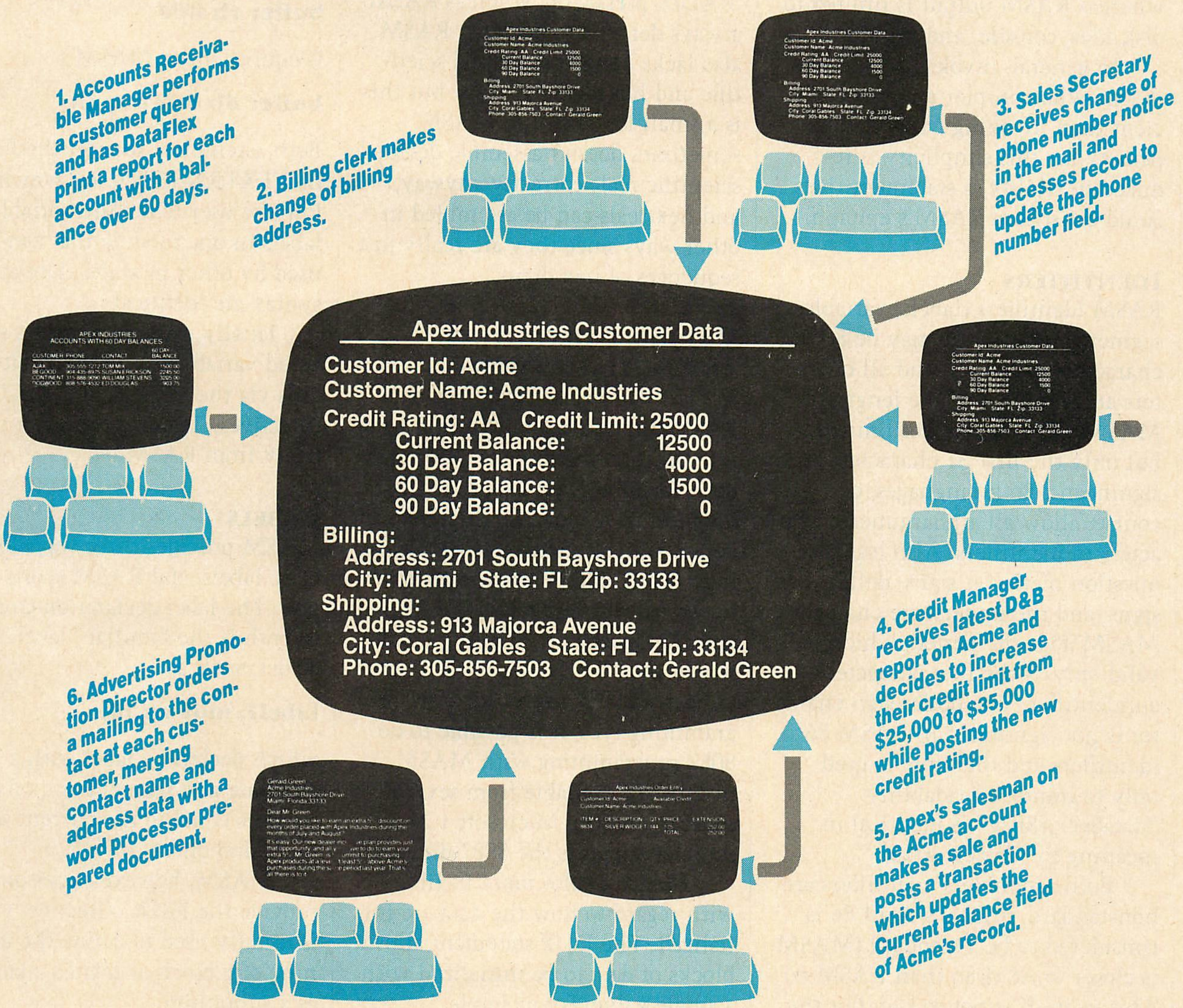
Four of the five options simply specify devices: the input device for the source file and the output devices for the object, symbol, and list files. The user has no choice as to RASM-86's output file names; he can select where the files will go, but not what they will be called. The file names will always be the same as the source file name, and the extensions will be .OBJ for the object file, .SYM for the symbol file, and .LST for the list file.

The fifth optional parameter, LO, instructs the assembler to include local symbols in the object file (MASM has no equivalent option). During linking, the LINK-86 program produces a symbol file based on the symbols contained in the object modules linked. If the LO parameter is omitted at assembly time, the linker's output symbol file will include public symbols (those named in PUBLIC statements in the source). If the LO parameter is included, *all* symbols declared in the source files will be contained in the linker's symbol file. This is useful, because the "S" in SID-86, the debugger, stands for *symbolic*. SID-86 can read the linker's symbol file, and the symbols can be used during debugging.

In contrast, MASM can be either command-driven or interactive. If options are not specified on the command line, the assembler will prompt for them. MASM options include the source, object, listing, and cross-reference file names. Unlike with RASM-86, complete file names, rather than just devices, can be specified. MASM command lines tend to be slightly longer than

ALL AT ONCE!

AND NEVER A "LOCKED OUT" USER!



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RASM-86 command lines. They are also position-dependent; I/O file names must be specified in the order listed above. MASM output can be directed to the serial port or to any other device defined to DOS, whereas RASM output is limited to disk files, console, and printer.

In general, invoking RASM-86 is somewhat simpler and more efficient than invoking MASM. The penalty for this simplicity is reduced flexibility, a statement that could constitute RASM's epitaph.

IDENTIFIERS

RASM identifiers (labels, variables, segment names, etc.) may be 80 characters in length, and all characters are significant. The length of MASM identifiers is not limited, but only the first 31 characters are significant. Both languages, of course, allow all alphanumeric characters in identifiers. Also legal are question marks, at signs, dollar signs, and the underscore character. MASM adds the period, which is valid only as the first character of an identifier. The dollar-sign character is not significant in RASM-86 identifiers and therefore is used only to improve readability: "data$error$flag" is identical in meaning to "dataerrorflag."

Both assemblers' identifiers are nonstandard, if Intel's ASM-86 is considered to be a standard (MASM is closer to ASM-86 than RASM is). This in itself is not so bad, but the fact that they are nonstandard in different ways could create problems in using the IBM/Microsoft linker to link RASM modules. (This will be covered later.)

CONSTANTS

Character and numeric constants in the two assemblers are similar. Character constants consist of one or two ASCII characters enclosed by delimiters. RASM-86 delimiters are single quotes; MASM delimiters are either single or double quotes. Both assemblers allow 16-bit numeric constants to be declared in binary, octal, decimal, or hexadecimal notation. The radix identifiers (B, O for RASM and Q, D, H for MASM) are the same. MASM allows the default number base to be changed via the .RADIX pseudo-op, whereas RASM always defaults to decimal. RASM also lacks MASM's decimal scientific and hexadecimal reals, but this is a small loss, because MASM sometimes doesn't assemble decimal scientific reals correctly anyway, and hex reals can be assembled in other ways since they are really just sequences of hex digits.

VARIABLE DEFINITION AND INITIALIZATION

MASM has a clear advantage over RASM-86 in its data definition and initialization capabilities. Although both assemblers provide the standard DB, DW, and DD directives to define variables with (respectively) byte, word, and doubleword attributes, MASM also offers the DQ and DT operations, defining quadwords and 10-byte variables. These are particularly useful for 8087 programming (yes, it is possible to do 8087 programming with MASM; macros are available from several sources, and the Microsoft 1.25 assembler supports the 8087 directly).

MASM is also more flexible with regard to how the data are initialized. The DUP statement allows blocks of data to be initialized with a single value. For example,

buffer dB 4000 dup (' ')

initializes a 4,000-byte buffer with ASCII blanks. As far as I have been able to determine, there is no way to do this in RASM-86.

RASM-86 has more subtle restrictions as well. For example, the DD operand can be used only with an address expression; that is, the statement

long_integer dd 123456

is not legal. This is a severe restriction, particularly if RASM is used with languages (such as C) that support long integer arithmetic.

RASM also does not support the indeterminate initializer, "?". Instead, the RS, RB, RW, and RD directives are substituted:

buffer rb 4000

is equivalent to MASM's

buffer db 4000 dup (?)

Both assemblers support the PUBLIC/EXTRN directives, which allow the user to declare variables and labels in one module that can be used by other modules. Use and syntax are identical.

Finally, MASM supports structured variables and packed bit-records via the STRUC and RECORD directives. These are missing entirely from RASM.

LABELS

MASM provides three ways to declare labels, and RASM sports only one. The label declaration common to both is the familiar "label:" construct, such as

label1: mov ax,100

which declares a label with a NEAR attribute and segment and offset attributes equal to the current segment and offset.

MASM, however, goes on to provide the PROC directive, which is usually used to define the beginning of a block of related code, such as a subroutine:

editor proc far

The label EDITOR will have segment/offset attributes as though it were declared with a colon, but it will have a FAR attribute; the PROC directive allows either a NEAR or FAR attribute to be specified for the label. The PROC declaration also tells the assembler whether to use a near or far return when RET statements are encountered. RASM requires the nonstandard mnemonic RETF to be used to specify a far return. (To call a far la-

bel, the CALLF instruction, also nonstandard, must be used.)

MASM also provides the LABEL pseudo-op, which allows the user to create a label at the current segment/offset location with any attribute he chooses: BYTE, WORD, DWORD, QWORD, TBYTE, NEAR, or FAR. Among other uses, LABEL can create multiple labels, with differing attributes, for the same location. RASM-86 does not have this facility.

Both assemblers include the "$" symbol, which creates a temporary near label with segment/offset attributes equal to the current segment and offset. MASM plays a little fast and loose with the $ label, particularly with regard to the segment attribute. Consider, for example, the following program fragment:

```
data segment
. . .
data ends
code segment
assume cs:code, ds:data
label1 equ $
        mov ax,$
        mov ax,label1
        . . .
code ends
```

Logically, the two MOV statements should assemble identically, but they do not. The second one assembles (correctly) with a segment override (CS:); the first does not. Thus, the first statement will move to AX the contents of the address generated by adding the current *code* offset to the current data segment register. Clearly, this is not what was intended by the programmer who wrote this fragment.

Table 1: *Comparison of Program Sizes of IBM/Microsoft and Digital Research Assembler Tools*

	IBM/Microsoft Macro Assembler 1.0 and DOS 2.0	**Size**	**DRI Assembler Plus Tools**	**Size**
Assembler	MASM.EXE	67584	RASM86.EXE	38912
Linker	LINK.EXE	39936	LINK86.EXE	42496
Cross-reference generator	CREF.EXE	13824	XREF86.EXE	19456
Debugger	DEBUG.COM	11904	SID86.COM	17920
Object code librarian	—	—	LIB86.EXE	14464

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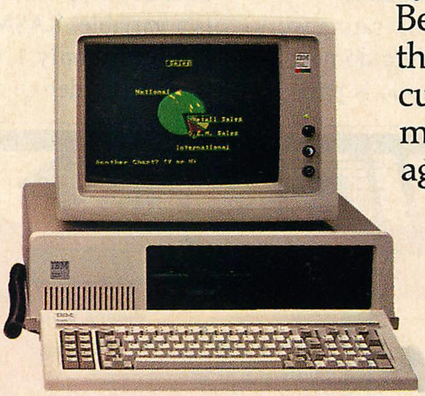

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Arithmetic, Logical, and Relational Operators

Both assemblers boast a full complement of arithmetic, logical, and relational operators. Arithmetic operators include addition, subtraction, multiplication, division, modulo division, and left/right bit shifts. Relational operators include all necessary tests of equality and inequality. Logical operators include AND, NOT, OR, and XOR. The syntax and notation is the same for both MASM and RASM.

Even though the two assemblers' capabilities appear to be identical, I'd score this round in RASM-86's favor, for two reasons. First, DRI has carefully documented all of these operators (and what types of operands are legal for each); IBM, on the other hand, mentions most of the operators only in passing, in a table of operator precedence.

Second, RASM's operators work correctly; MASM's often do not. In fact, MASM's arithmetic is positively disgraceful. (For an interesting exposé of MASM's arithmetic and logic, see Ray Duncan's article in the February 1984 issue of *Dr. Dobb's Journal*; I recommend that MASM users read this article before trying to use any MASM arithmetic in their programs.)

Attribute and Value Operators

The SEG, OFFSET, and PTR operators are identical in the two assemblers. SEG and OFFSET return the segment and offset values of their respective operands. PTR temporarily changes the type or distance attribute of its operand (BYTE, WORD, or DOUBLEWORD; NEAR or FAR) to a specified type or distance.

The TYPE operator returns a number reflecting the "type" attribute of its operand, if that operand is a variable. RASM's TYPE operator can return only 1, 2, or 4, because RASM can define only BYTE, WORD, and DOUBLEWORD variables. MASM can return 1, 2, 4, 8, 10, or (if its operand is a structure) a structure size. MASM can also return the NEAR or FAR attribute of an operand that is a label. Digital Research's documentation does not specify what is returned if the TYPE operator is used with a label operand, although it does state that TYPE can be used with a label.

The functioning of the LENGTH operator in the two assemblers is subtly different. MASM's LENGTH returns the number of elements in a DUP'd array; it is not meaningful for other variables. RASM's LENGTH returns the actual number of bytes associated with a variable. So, RASM's LENGTH is similar to MASM's SIZE. However, SIZE, like MASM's LENGTH, is meaningful only for variables declared with a DUP initializer (SIZE = LENGTH * TYPE). Note that the actual utility of RASM's LENGTH operator is lim-

ited by the deficiencies of the assembler's data definition capability. Because there are no structures or initializing DUP statements, the definition of a variable (as far as LENGTH is concerned) can consist of only as much code as can be packed into one line of source.

RASM-86 also provides a LAST operator: if LENGTH **x** is greater than 0, LAST **x** returns LENGTH **x** − 1; if LENGTH **x** is 0, LAST **x** returns 0. This feature provides a convenient means to access, for example, the last element of an array. The LAST operator is not present in IBM's MASM. LAST shares LENGTH's limitation as it was described above.

MASM includes several attribute operators that are not present in RASM-86. The SHORT operator, for example, specifies that the target label of a jump instruction be within 127 bytes of the instruction. RASM-86 uses the nonstandard mnemonic JMPS for the same purpose. MASM's THIS operator defines a memory location and specifies a type attribute. It is also missing in RASM, but I have yet to find a use for THIS that cannot be duplicated by using other means.

Obviously, all of the operators that deal with records and structures are also missing from RASM-86: specifically, MASM's shift count, MASK, WIDTH, and dot (.) operators are not implemented in RASM. RASM does have a dot operator, but its meaning is entirely different. The dot in MASM specifies that one field of a structure is being referred to (e.g., customer.name); in RASM it creates a temporary variable in the current data segment. For example, the RASM statement

```
mov ax, .380H
```

is equivalent to MASM's

```
mov ax,ds:[380H]
```

Finally, MASM's HIGH and LOW operators, which return the high and low bytes of a 16-bit value, are not present in RASM-86.

Program Segmentation

The two assemblers part company on program segmentation. Program segments are defined in MASM with the SEGMENT/ENDS pair. The SEGMENT directive defines the beginning of a logical program segment: an area of code, data, stack, etc. SEGMENT syntax is

```
name SEGMENT [align-type]
    [combine-type] ['classname']
```

The name field tells the assembler and the linker what name to use for the segment; it can be any unique MASM identifier. The align-type instructs the assembler where to align the beginning of the segment. Valid align-types are BYTE, WORD, PARA, and PAGE. The combine-type specifies how segments with the same name are to be combined at link time; it can be PUBLIC, COMMON, STACK, MEMORY, or

AT. Finally, the classname is a user-defined string; the linker will place segments with the same classname near one another in memory.

The purpose of all this is to tell the assembler and linker what the segment is to be used for, how it will be combined with other program segments, and where it should be placed in memory. MASM's SEGMENT directive is complete: it allows the programmer to do almost anything he wants. In fact, it is a virtually complete implementation of the Intel assembler's SEGMENT directive, missing only that assembler's INPAGE align-type.

As a necessary complement to the SEGMENT directive, MASM provides the important ASSUME statement. Aside from affording programmers the opportunity to code the most sagacious statement I have ever seen in any computer language ("ASSUME NOTHING"), the ASSUME directive tells the assembler what values it can expect to be in the segment registers at run time. This is critical information, because the assembler must know how to address variables and code. Examine the following program fragment:

```
data segment public
var1 db ?
data ends

code segment public
assume cs:code,ds:nothing,
  es:data
  mov ah,var1
  . . .
code ends
```

The ASSUME statement tells the assembler that to address VAR1 in the data segment it must use a segment override; the assembler will actually generate the instruction

```
mov ah,es:var1
```

because it was informed that what will be in the DS register at run-time is unknown.

Finally, the GROUP directive in MASM instructs the assembler/linker to collect a set of logical pro-

gram segments into one contiguous physical segment of 64K or less. All segments so collected can be addressed via a single segment register; that is, offset addresses are relative to the base of the group, not to the base of each segment.

With SEGMENT/ENDS, ASSUME, and GROUP, the MASM programmer has all of the tools necessary to exercise complete control over program segmentation, use of segment registers, and generation of segment overrides for addressing. In contrast, RASM-86 has only those tools needed to get the job done.

RASM's segmentation directive is a simplified version of the SEGMENT statement. The only align-types available are BYTE, WORD, and PARA, and the only combine-types are PUBLIC and COMMON; there is no classname field. The actual syntax is

[seg-name] seg-type
[align-type] [combine-type]

in which seg-type must be CSEG, DSEG, ESEG, or SSEG. RASM makes all kinds of assumptions based on the seg-type. For example, if the word "CSEG" is included in a file, RASM assumes a seg-name of CODE, an align-type of BYTE, and a combine-type of PUBLIC (all of which, however, can be overridden).

Further, RASM does not have an ASSUME statement. RASM makes its own assumptions; if they are not what the programmer wants, that's too bad. RASM's assumptions are established by the seg-type of the segment in which the symbol being referenced is located (although this is not mentioned in DRI's documentation).

For example, if variable VAR1 is declared in an ESEG, any references to VAR1 are coded by RASM as ES:VAR1. There is no way to tell the assembler that DS also points to the ESEG. If DS does, in fact, refer to the ESEG containing VAR1, all references must be explicitly coded as DS:VAR1 in order to avoid all those unnecessary ES overrides.

In some cases, the programmer can trick RASM into doing what he wants. For example, in the creation of a COM file, variables can be put in a DSEG, and then the code and data segments can be GROUPed together. (If the variables were placed in the code segment, as would be the case in a MASM-produced COM file, RASM would prefix every reference to every variable with a CS override.) However, there are many cases in which this sort of grouping will not work, and the programmer will be forced to code his own overrides. The lack of the ASSUME statement is a serious deficiency.

Obviously, RASM does provide the GROUP directive, albeit somewhat differently from MASM. First, the OFFSET operator always returns the offset of a symbol within its group, never within its segment; MASM allows either offset to be accessed. Second, I have not been able

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to find any use for the group name. It is accepted neither as an operand nor as a modifier. If the programmer needs the segment address of the group, he must request the address of the first segment in the group. Finally, RASM requires the use of far jumps and calls between segments that have been grouped; the assembler does not take advantage of the grouping. MASM permits near jumps and calls between grouped segments.

Macros and Conditionals

There's no comparison between MASM and RASM-86 regarding macros and conditionals. RASM-86 has only a limited conditional assembly capability, and does not support traditional text macros at all.

MASM's conditionals test the zero/nonzero value of an expression, whether two symbols (usually macro parameters) are identical, whether a symbol is present or absent (again, usually a parameter), whether a symbol is defined, and whether the assembler is currently executing pass 1 or pass 2. RASM-86 provides only the first test.

The absence of macros in RASM will not concern some people, but I use macros extensively and would disqualify RASM-86 from consideration as a serious assembler on this point alone. Macros can provide program structuring; they can generate local variables on the stack so that subroutines can be made automatically reentrant; they can simplify repetitive sections of code; above all, when they are used correctly, they can make programs more easily understood and maintained.

Figure 2 shows an example of MASM macro use. I would probably more easily understand the fragment in this figure six months after I wrote it than I would an extended series of register moves, interrupts, subroutine calls, compares, and conditional branches, no matter how well the code was commented.

RASM-86 does, however, have a code-macro facility. Code-macros essentially allow the programmer to define 8088 instructions; the assembler uses code-macros internally

Figure 2: *Example of MASM Macro Use*

```
cls
locate 0,0
.repeat
    read_char
        .if EOL
                print_result
        .else
                write_char
                parse
        .endif
.until EOF
```

to generate opcodes. This facility is interesting, but not very useful. As an example, the following code-macro generates a MOV to the CS register, which is supposed to be illegal on the 8088:

```
codemacro MOV dst:S(CS) ,
  src:Ew
segfix src
db 8EH
modrm dst,src
EndM
```

Briefly, the above series of directives instructs the assembler to watch for any MOV instruction whose destination is the CS segment register. When it finds one, it will construct a multi-byte opcode, prefixed by a segment override if necessary. The first byte will be 8EH. The rest of the opcode is based on the nature of the operand: it will consist of the standard 8086/88 ModRM byte, possibly followed by addressing bytes. Any of these statements can then be assembled:

```
mov cs,ax
mov cs,seg_ptr
mov cs,es:6[bx+si]
```

In fact, any type of move for which the DS register is a legal des-

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tination can now be duplicated with CS. (Note: skeptics may want to try this out in DEBUG. Version 2.0 will actually assemble and execute moves to the CS register if it is asked to.) However, I do not recommend using CS moves in programs. This method works on current versions of the 8088, but it is documented as illegal, and it may not work on future versions of the chip.

In any event, code-macros do not substitute for text macros. Code-macros do not allow the programmer to do the same operations that he can do with text macros (nor, in fairness, are they intended to). The lack of a macro processor is a critical deficiency in RASM-86.

COMPATIBILITY

Knowing that significant differences exist between RASM-86 and MASM, no one should be surprised that RASM-86 will not correctly assemble a program written for MASM. The actual scope of the task of converting a MASM file to assemble under RASM depends on the sophistication of the original file. A file containing macros, structures and records, complex data declarations, and multiple ASSUME statements will require a good deal of work to convert.

Aware that there would be errors, I tried to use RASM-86 to assemble SDIR, John Chapman's public-domain sorted directory program. RASM flagged no fewer than 284 errors in SDIR, a file of about 48K (half or more of which is made up of comments). On the other hand, a simple file (such as one written for IBM's "small" assembler, ASM, which lacks many of the same features missing in RASM) may be converted fairly painlessly, by changing the segment declarations, removing the PROC and ASSUME statements, and assembling.

As a sample of the conversion task, I altered IBM's virtual disk device driver (from the DOS 2.0 reference manual, beginning on page 14-27) to assemble under RASM-86. The following steps were needed:

1. Convert macros to in-line code.
2. Remove PROC/ENDP pairs. Restate the proc

Table 2: *Comparative Assembly Times*

	RASM-86	MASM	MASM/MACROS
Empty file	0:03.3	0:03.7	–
4K	0:16.5	0:16.0	0:23.0
8K	0:32.3	0:49.9	0:57.0
16K	0:35.1	0:45.7	0:48.0
48K	1:41.0	2:33.7	0:40.5

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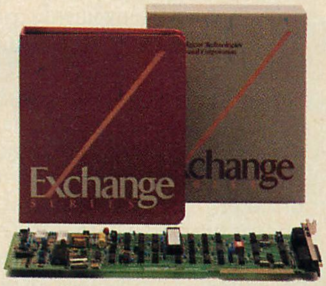

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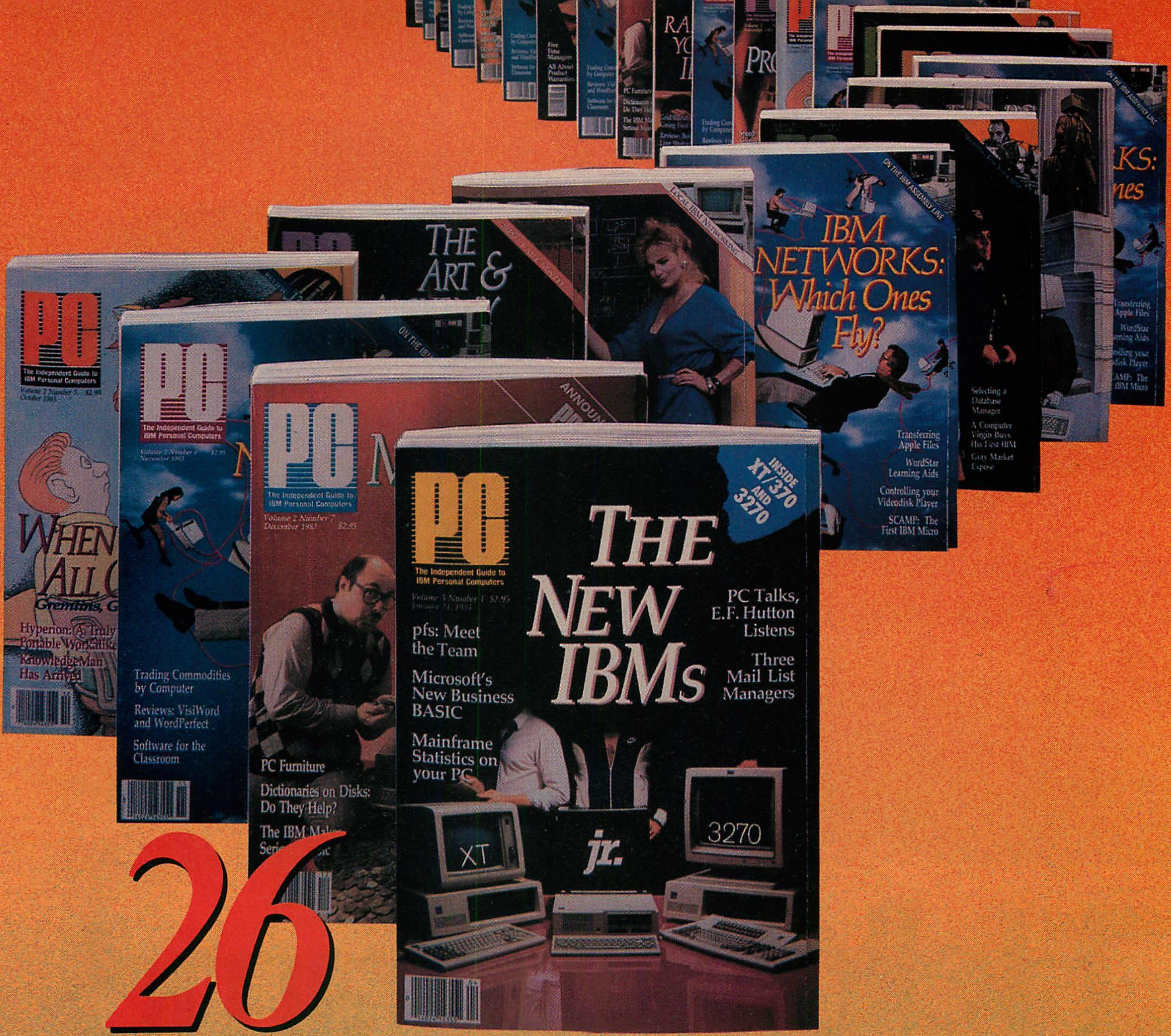

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names as regular labels. Change the RET statements in the FAR procs to RETF.

3. Fix syntax of segment declaration. Remove ASSUMEs.
4. Fix DUP and "DW ?" statements.
5. Alter the "DD -1" in the device header to two DWs.
6. Change one LABEL statement to the "label:" construct.
7. Change all LEAs to MOV/OFFSET statements. (This should not have been necessary, but it was; the LEA statements would not assemble without error.)
8. Change all references to labels in the IF statement from "label" to "offset label."
9. Alter a few listing control statements.

The virtual disk conversion was, no doubt, a fairly simple one. There were no records or structures, a few small macros, and one segment.

Incidentally, even when the obvious changes are made in a conversion task, minor differences will still remain in syntax. For example, the MASM statements

mov byte ptr es:[bx], 13
mov [si+6], al

must be coded in RASM as

mov es:byte ptr [bx], 13
mov 6[si], al

The issue of object module compatibility is more interesting. Obviously, code that is assembled/linked with RASM is compatible with DOS; what I am speaking of here is the compatibility of RASM's unlinked OBJ files with the PC-DOS linker. The official word from DRI would make any New Englander proud: "Mebbe 'tis, mebbe 'tain't." Digital Research does not claim compatibility in that area, does not support the DOS linker, and is not responsible if RASM object files cannot be linked in that manner.

The fact is that it usually works fine. Both linkers use Intel-type object module formats, and, in several weeks of testing, I created no file that the PC-DOS linker rejected (except as noted in the next paragraph). Furthermore, all of the files I tried executed properly.

Certainly, that is not to say that it will always work. One potential problem lies in the area of identifiers. RASM identifiers are significant to 80 characters, and it is quite possible that LINK, expecting only 31 characters, would choke on long identifiers. A few quick tests indicated that, in fact, LINK did not mind 40-character public symbols. However, it did fail (without comment) if there were two RASM identifiers that differed only after the first 31 characters.

If it's possible to use PC-DOS's LINK on RASM-produced files, it makes sense that it would also be possible to use LINK-86 on MASM files, and, indeed, that appears to be true. Although I ran fewer tests in this direction, I had no difficulty linking MASM object files with the DRI linker. Again, however, there are potential problems. It is unclear, for example, what LINK-86 would do if it were to encounter one of MASM's MEMORY segments, since MEMORY is not one of RASM's segment types.

The implication of this semi-compatibility is that it may well be possible to use RASM to produce small assembly language subroutines for compiled languages that produce Microsoft-style object files. I successfully linked a RASM-assembled subroutine with a C program written under Computer Innovations' C86 compiler. In view of RASM's potential for the production of simple programs or subroutines, this is good news.

Perhaps more importantly, it should also be feasible to use the greater power of MASM in the production of assembly language modules for the DRI languages. This

would spare MASM owners the expense of buying another assembler.

PERFORMANCE

As I mentioned earlier, one of the factors contributing to the excitement that greeted the news of RASM's release was that it was supposed to be significantly faster than MASM. Indeed, RASM is somewhat faster, though perhaps not as much as had been hoped.

Table 2 lists assembly times for five files ranging in size from a few bytes to about 48K. The "empty" file is a minimum assembly language file, consisting of a single END statement; this timing shows how long it takes simply to load and execute the two assemblers. The tests were conducted on a standard IBM PC with 512K of RAM and a Davong hard disk. The timings include load time from the Davong. Both assemblers were instructed to create object files only—no listing, symbol, or cross-reference files.

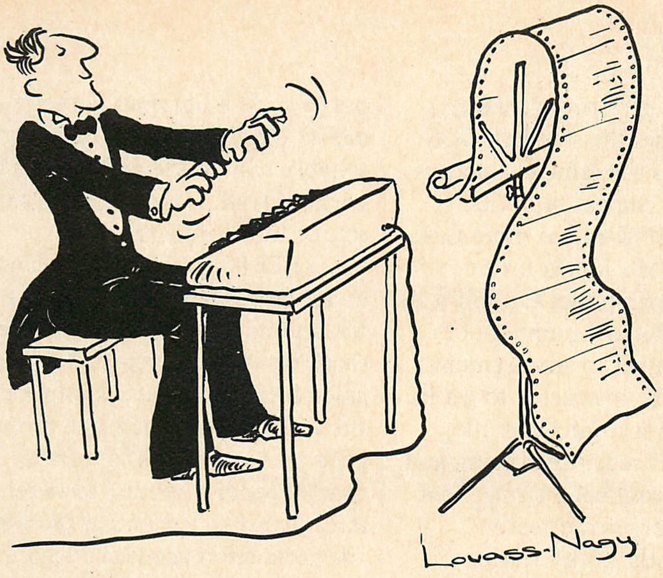
Obviously, since the assemblers are not source-compatible, the files used for comparison are not identical; however, I attempted to make as few alterations as possible in converting. There are two MASM timings for each file. The MACRO column shows the timings for the files in their original condition, including all macros, and the MASM column shows the timings for the files after all macros had been converted to in-line code. All other MASM code, such as structures and structure references, remained intact.

The timing information clearly shows that RASM's performance improves relative to MASM as the size of the file being assembled increases. For small files, there was very little difference; MASM was actually a little faster for a very small (3.5K) file. On the other end of the scale, RASM was much faster than MASM in assembling the largest file, the 48K SDIR program. RASM completed the job in 1 minute, 41 seconds, whereas MASM took 3 minutes, 40 seconds.

Bear in mind that the version of SDIR being tested makes fairly extensive use of macros and structures. As a result, it's readable, understandable, and maintainable, even by someone who didn't write it. For example, I have no difficulty understanding what the SDIR code does. The same code, after conversion, was much less clear. If I were going to make any changes to the program, I would still use the original MASM version. The extra few minutes spent assembling are a small price to pay for a more significant (though unmeasurable) reduction in coding and maintenance time.

THE REST OF THE TOOLS

As mentioned above, RASM-86 is one part of a DRI package called Assembler Plus Tools, including the linker, an object librarian, a cross-referencer, and a debugger.



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LINK-86 performs the same function as does the standard DOS linker and has the same characteristics regarding compatibility. In some ways, LINK-86 has more flexibility than IBM's LINK; for example, the programmer can tell it to allocate an arbitrary number of extra (unused) bytes to any segment. LINK-86 can be instructed to get its command input from a disk file, which reduces repetitive typing and permits long command strings that could not be entered directly.

One slightly tricky feature of LINK-86 is the NOPREFIX option. The linker normally adds some prefix code at the beginning of the linked EXE file. According to DRI, the prefix code allows the linked program to behave as though it were running under CP/M-86. The prefix code is required for linking object modules created by DRI's compilers, but it is not needed for linking only RASM-86 modules.

NOPREFIX suppresses the prefix code and produces a standard EXE file. The option must be used to convert the EXE file to COM format; because the prefix code contains segment references.

As far as I could tell, LINK-86 cannot create a high-loading code file; RASM has no functions equivalent to the IBM linker's /HIGH and /DSALLOCATION switches.

LIB-86 is an object code librarian. That is, it permits object modules to be separately assembled and placed into a library file for future use during the link process. For example, a CLS procedure to clear the screen might be created, assembled, and placed into a library. CLS could then be declared as an external label in any RASM source file, and the linker will extract the module from the library when it is needed.

The advantage to using object libraries is that the programmer can avoid cluttering up disk storage with too many small modules, thus simplifying disk maintenance and reducing wasted space. PC-DOS does not provide a librarian (although, oddly, MS-DOS does). LIB-86 is reasonably easy to use and appears to perform well. Unfortunately, no source librarian is provided.

XREF-86 is an assembly language cross referencer. It reads a list file and its associated symbol file (both of which are created by the assembler) and creates a duplicate of the list file, with each line of source code prefixed by a line number. It then appends a symbol cross-reference listing to the end of the file; the cross reference lists all symbols and indicates where they are defined and/or referenced. XREF-86 is similar to IBM's CREF program.

The final part of the Assembler Plus Tools package is the debugger, SID-86. In many ways, SID is similar to PC-DOS's DEBUG, but it has one major advantage: SID can read the symbol file created by LINK-86 and use the symbols contained therein. Thus, during a SID-86 run, the programmer can refer to variables and labels by name, rather than having to use the listings and symbol files directly. Symbols also appear in the disassembly:

```
GET_INPUT:
xxxx:0100 CALL 01C6
  .GET_KEY
xxxx:0103 MOV 0017, AX
  .INCHAR
xxxx:0106 LOOP 0100
  GET INPUT
```

Using symbols lessens the pain of the debugging process considerably. SID and DEBUG are both command-driven debuggers, but the commands are just different enough to be confusing. SID seems to have all the functions DEBUG does, plus a few more (decimal data entry, direct creation of an input command tail, fancier breakpoints, tracing with calls executed in full, etc.). One curious omission is that RASM-86 supports 8087 mnemonics, but SID does not. Although DRI would not officially confirm our information, industry sources say that

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the company is planning to include 8087 support in a future release.

My only real complaint about SID-86 is that the trace (single-step) display shows the machine state *prior* to the most recently executed instruction: in other words, the programmer cannot see the results of a traced instruction until after he has traced the next instruction.

CONCLUSION

A few months ago, during a CompuServe on-line conference on IBM's MASM, a frustrated newcomer to PC assembly language programming wailed, "Isn't there any way to just ORG and go? Why do I have to ASSUME and SEGMENT and PROC and all that stuff?"

ORG and go. Well, if that's what you want, maybe DRI's RASM-86 will be just your cup of tea. But I keep thinking back to the response given the CompuServe newcomer: the reason that MASM is a little more complex than a Z80 assembler is that the chip it creates programs for is a *lot* more complex. MASM's role in life is to let the programmer take advantage of the flexibility of the PC's brain.

The price for RASM's relative simplicity is loss of control over the CPU; the price for RASM's smallness is loss of flexibility in manipulating the objects that are created. If you don't need those functions, RASM may be a good choice for you. As for me, I'm sticking with IBM's Macro Assembler.

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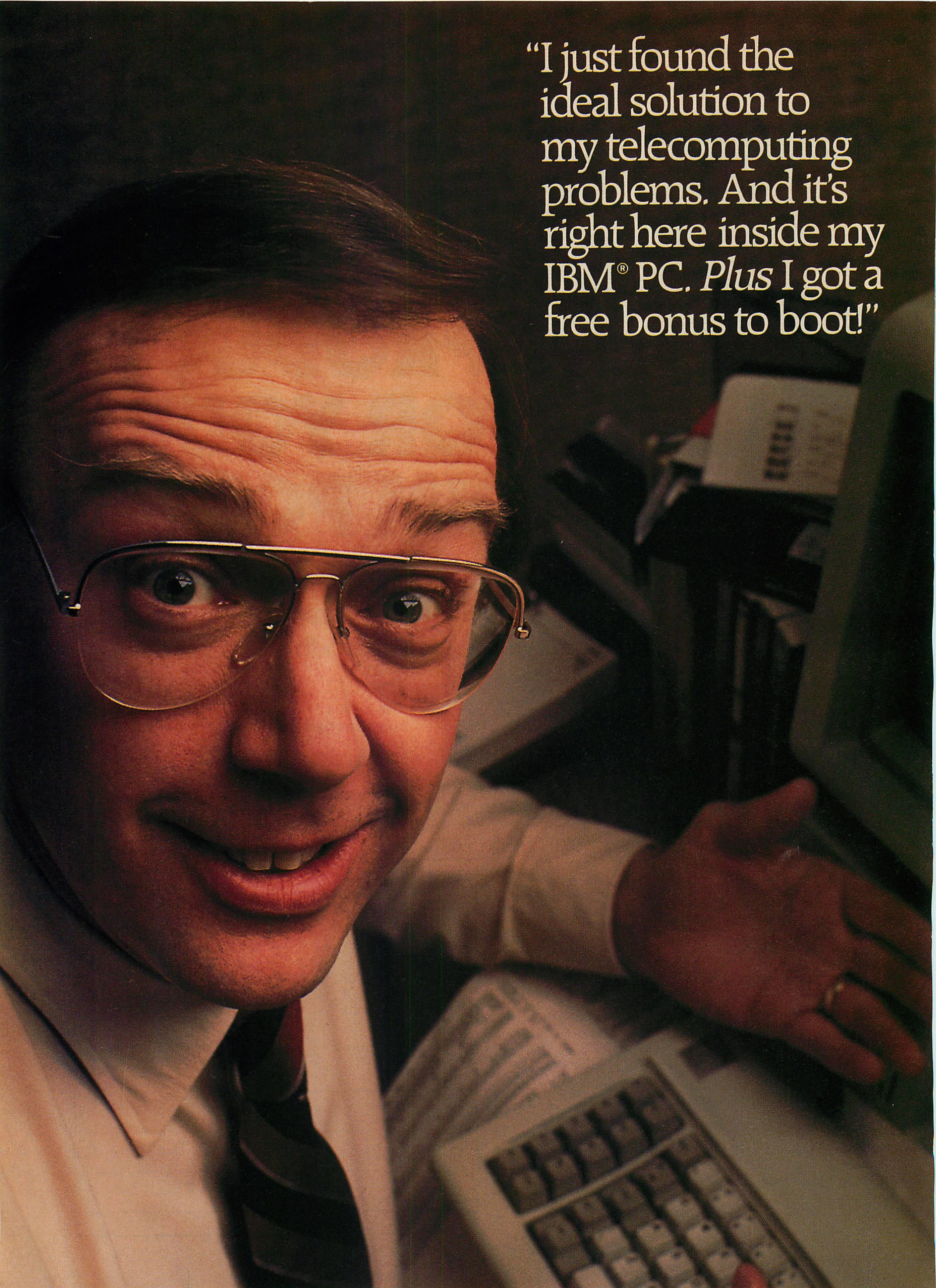
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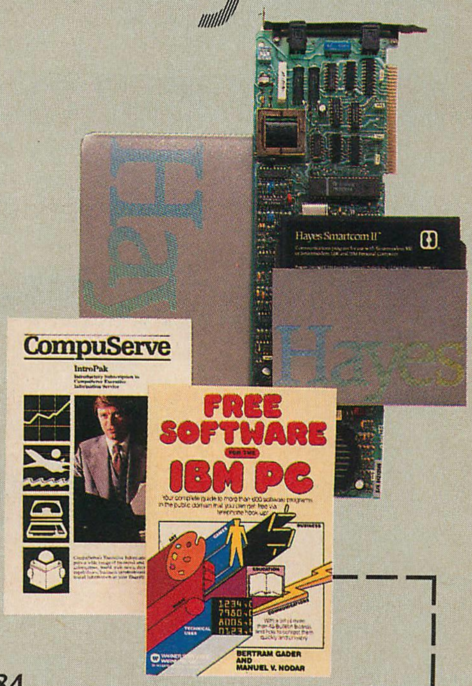

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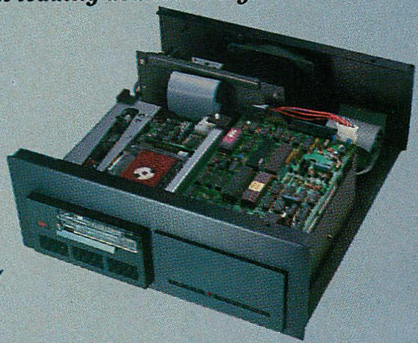

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AUGIE HANSEN

ACS or PCM: THE BETTER TO COMMUNICATE WITH

Depending upon the prescribed use, either of these IBM communications packages could outperform the other

Among communications products on the software shelves today are two from IBM—one works well for mainframe communications but not so well for general or personal use; the other fills in the gap for general or personal use and is especially well-suited to electronic mail functions. The first product is an updated version of IBM's Asynchronous Communications Support package (ACS). The second is Microcom's Personal Communications Manager (PCM) draped in the wraps and banner of IBM.

Asynchronous Communications Support was one of the first communications packages available for the PC. ACS was and is basically a dumb terminal emulator with some capabilities added to permit file transfers with IBM host machines. The Personal Communications Manager is a neat package designed to whisk the user and his PC into the age of the electronic, or paperless, office. PCM handles several types of mail electronically in unattended send/receive operation and even has a terminal emulation mode.

Both of these programs were tested for the following review on a variety of machines in the PC family, talking to each other and to a range of other host machines.

Augie Hansen is a programmer for a major telecommunications company. His interests include commercial and amateur radio communications. He is the author of Chrome Ranger, an arcade game for the IBM PC that is published by Omniware.

Asynchronous Communications Support, Version 2.0

IBM's first attempt at communications software for the PC did reasonably well in the marketplace, largely because of a dearth of competition. The ACS package worked well with IBM host systems, but it offered little except dumb-terminal features for users of bulletin boards and other mainframe and minicomputer operating systems.

Its strongest following appears to be in the business community, in which literally tons of IBM mainframe equipment hold down little squares of raised flooring in flass and steel structures around the globe. Most communicators of the shirtsleeves bulletin-board crowd, on the other hand, prefer PC-TALK and other such programs that were designed for that environment.

ACS's version 2.0 is an improvement over its predecessor. It is still completely menu driven, which disappoints those who ascribe to the command-oriented approach, but it's a serviceable product. Several deficiencies of the original product have been rectified (destructive backspace works now) and some new features have been added. Table 1 is a summary of new and revised ACS features. Additions include a much-needed help feature, support for a second serial adapter card in case the first is committed to some other task, and control character filtering. In addition, ACS now has more of a general-purpose file transfer capability and the ability to capture data to a printer and to disk.

Like its predecessor, the new version of ACS is not copy protected and may be run on virtually any IBM PC or clone having at least 64K RAM, a floppy or hard disk drive, either an async port card and modem or an internal modem, and either a 40- or an 80-column display.

IBM has added displays of the default values of the communications parameters to the terminal feature menu (see figure 1) so the user doesn't have to make unnecessary menu selections just to find out the current settings. The procedure would have been even easier, however, had IBM put the three items that don't change from one terminal menu to the next, such as 1-3, in the same location. Then, the user would not have to press 13 to start one "type" and 3 to start some other "type." The quotes are used because the terminal feature files do not really define terminal types. Rather, they simply set the basic communications parameters for the particular host environment in question.

Feature Description	Status	Comments
Terminal selection Dow Jones/The Source	new	Added to top-level menu selections
User-specified	revised	Combines user-specified full- and half-duplex entries
Terminal session printing	new	<F7> toggles ON/OFF
Data capture to file	new	<F8> toggles ON/OFF
General purpose file transfer protocols	new	XON/OFF control flow
	new	Prompted (CR)
COM2 support	new	Option in set-up file
Control character filtering	new	Up to 4 and sets
HELP menu in terminal mode	new	Invoke with <F10>
File format conversion	new	Binary-ASCII & back

Table 1: Summary of New and Revised Features of ACS 2.0

One of the choices offered for terminal descriptions is which control characters to delete upon receipt. Figure 2 shows the menu/work screen that is used to select the first control character to delete. The user can select up to four, with any one of the selections being all of the unused control characters (those that are not used for normal screen and printer formatting).

File Transfers

Version 1.0 of Asynchronous Communications Support allowed files to be transferred between IBM PCs and between the PC and IBM mainframe hosts running MVS/TSO and VM/370 operating systems, if the needed line-oriented editors were available. Version 2.0 adds support for sending files to remote systems using either XON/XOFF flow control or prompting with a carriage-return character. This function is called *file sending*. Files may be received in unattended auto-answer mode using the *file writing* function. The user can name only one file that will receive transferred data, whether the data consist of one character or a hundred files. The individual files must be extracted at a later time.

A file conversion program enables the user to send and receive binary files as ASCII text files. The process makes a file to be sent swell to twice its original size and doubles the transmission time compared to an ASCII file of the same original size. Even worse, to send a binary file the user must leave ACS to use the separate FILECONV program, then go back into ACS to use the file transfer function. The procedure is reversed for receiving a file. That is the price for ACS's use of seven data bits instead of eight. Furthermore, if the user is in the file-writing mode and is sent an unconverted binary file, the editor may be unable to sort the file's contents.

```
Terminal Feature Menu
Choose:

    1 Line Bit Rate [300]
    2 Type of Parity Checking [Mark]
    3 Number of Stop Bits [One Bit]
    4 XON/XOFF Support [Present]
    5 Line Turnaround Char Sent to Host [CR]
    6 Local or Host Character Echoing [Local]
    7 First Character to be Deleted  [None]
    8 Second Character to be Deleted [None]
    9 Third Character to be Deleted  [None]
   10 Fourth Character to be Deleted [None]
   11 Line End Character Sent by Host [CR]
   12 Communications Adapter Address [1]
   13 Start Up Selected Terminal
   14 Save This Terminal Specification
   15 Return to Terminal Selection Menu

Type number and press Enter _
```

Figure 1: ACS Terminal Feature Menu

```
First Character to be Deleted
Choose:

** 1 No Character Specified
   2 Carriage Return (HEX 0D)
   3 Linefeed (HEX 0A)
   4 Bell (HEX 07)
   5 XON (HEX 11)
   6 XOFF (HEX 13)
   7 Escape (HEX 1B)
   8 Tab (HEX 09)
   9 Backspace (HEX 08)
  10 All Unused Control Characters
** Indicates current default

Type number and press Enter _
```

Figure 2: Selective Deletion of Received Characters in ACS

Data Capture

ACS version 2.0 allows the user to record what he receives either to a printer or to a disk. IBM calls these functions *terminal session printing* and *writing of host output to a file*. Most communications programs call the process of writing to a file (or to memory) *data capture*, but IBM, as usual, takes its own course.

What does the user do if he cannot remember—or never learned—the command to start data capture to disk? Figure 3 shows an interactive session in progress and illustrates the effect of pressing the F10 key to get on-screen help, a feature that was not available in the earlier version of the program.

The F7 and F8 keys toggle data capture to the printer and disk, respectively. The printing and disk writing functions may be run simultaneously. If the host computer recognizes and responds quickly to the XON/XOFF control codes, no data will be lost. If the response is too slow, the data can be captured to disk only and printed out later.

The ACS package interacts well with IBM mainframe computers and other IBM PCs and work-alikes. The mainframe connection appears to be the primary reason that version 2.0 is selling well. File transfers and general system interactions in these environments are smooth and essentially trouble-free.

In other environments, however, ACS provides little or no help with any task requiring more than a simple dumb-terminal interface. The XMODEM protocol, because of its wide acceptance in the microcomputer world, would have been a welcome addition to ACS to enhance its use in transferring files to and from bulletin boards and other such systems. The flow control and prompted techniques incorporated into version 2.0 are a step in the right direction but represent only a partial solution to the general problem of file transfers.

Another much-needed feature is a dialing directory. This would avoid the manual repetition of tasks such as finding a telephone number and keying it in each time a call is started, which is especially annoying if the call is to a busy system.

Regardless of the host environment involved, perhaps the most troublesome aspect of ACS is its poor user interface. In a word, it is tedious. Menus have a place, especially for the novice or infrequent user of a program, but they really slow down and irritate even moderately experienced users. Programs should provide a method to bypass certain steps if the user knows what to do without getting screens full of instructions and help messages.

ACS prevents accidental data loss in download situations by offering the options of exiting the function (E), appending to the named receiving file (A), or overwriting it (O). The product, however, does not have a directory-listing display of disks that can be used to find out the name of a file to send. The user must guess what's on the disks.

There is a way to get a directory listing, although it's undocumented: quit the program by typing Ctrl-Break (type it twice if necessary) and use the FILES command in the BASIC interpreter to get the directory listing, then type CONT to return to the ACS program. Depending on where the user was within ACS when he broke out, he may have to hit ENTER a couple of times to restart the program.

A few additional complaints: the program is slow to load, even when the TERMINAL.BAS file is in the tokenized storage format; the screen displays of incoming data are jerky because of the method used to display data from the receiving buffer; and the program will not allow the line to be disconnected until the

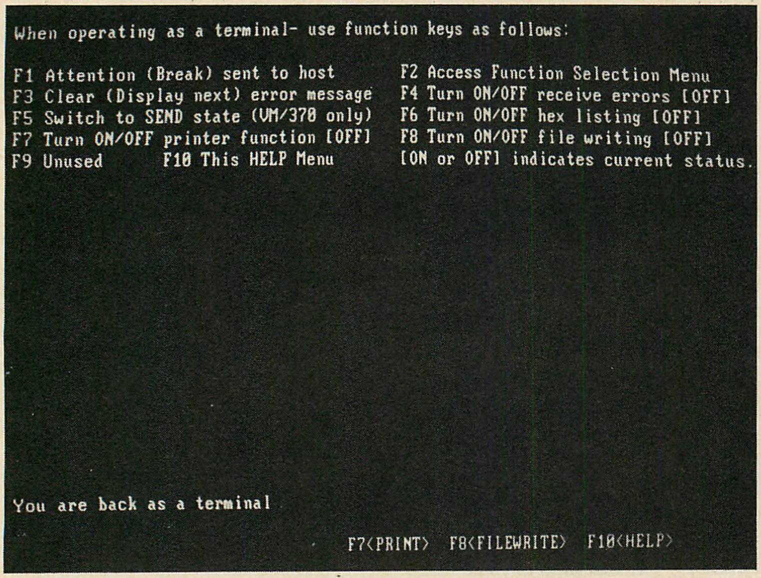

Figure 3: ACS Help Display During Terminal Session

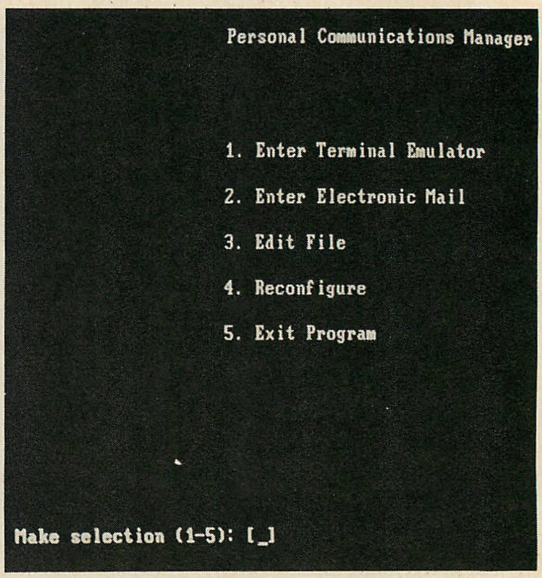

Figure 4: PCM Top-level Menu

other end drops off—the modem must be turned off, which is not convenient with built-ins. The disconnect problem occurs with systems, such as UNIX, that wait for another user to log in on a terminal just vacated by someone else.

Personal Communications Manager

PCM consists of several modules, some written in assembly language and some in compiled BASIC. The file PCM.COM calls the main program, MC1.EXE (which contains the top-level menu and the code for terminal emulation, configuration, and linkages), to the selected editor and to the electronic mail module. PCM is not copy protected, so necessary back-ups can be made and in-

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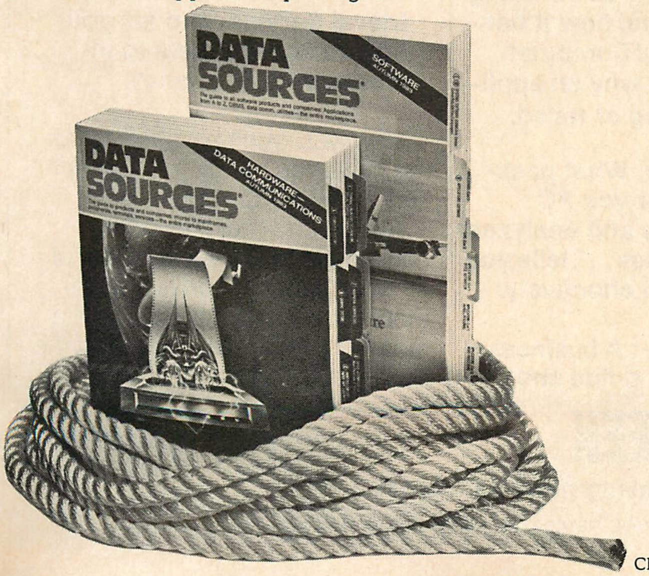

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stalled on any IBM PC-compatible system with at least 128K of RAM and one of the following minimum disk configurations:

- two single-sided disk drives
- one or two double-sided disk drives
- one fixed-disk drive and one disk drive.

Each original of the program bears a serial number. Copies of the same PCM program diskette are prevented from talking to each other to gain some measure of protection against software pirates. PCM operates in the PC-DOS 2.1 environment so that it may work on all current IBM PCs, including PC*jr*. The necessary DOS 2.1 files are included with the package. Set-up files that take care of the picky details are also included for each of the supported configurations. No problems were encountered in setting up PCM for three different versions of the PC and one work-alike. A communica-

Electronic mail

1. **Send/Receive mail**
   - Send/Receive work mail screen
   - Send/Receive status display
2. **Review/Address outgoing Mail**
   1. Address mail
      1. Address message to mailbox
      2. Address message to list
      3. Address message to phone number
      4. Address data to mailbox
      5. Address data to list
      6. Address data to phone number
      7. Display directory (disk)
   2. Review log
   3. Print log
   4. Print mail
   5. Retry mail not sent
   6. Delete mail already sent
   7. Delete all mail
3. **Review incoming mail**
   1. Review log
   2. Print log
   3. Print text
   4. Delete all mail
4. **Address book maintenance**
   1. Mailbox maintenance
   2. List maintenance
   3. Display mailboxes
   4. Display lists
   5. Print address book

Table 2: PCM Electronic Mail—Hierarchy of Menus and Work Screens

tions path is needed through a 103- or 212A-compatible modem that is smart enough to respond to commands to dial, detect incoming calls, pass 8-bit data, and hang up.

Figure 4 shows the PCM top-level menu. Selections are made by typing a number followed by ENTER. In addition to a configuration form for customization, PCM has an interesting editor function and two major modes of operation: unattended electronic mail and attended terminal emulation for general communication with information services and other host computers.

Personal Communications Manager has no built-in editor for creating and modifying mail items. Instead, it allows the user to specify the editor of his choice by writing the editor's name on a configuration form. The editor program file(s) must be on disk in a place accessible to PCM. The EDLIN program provided with PC-DOS is used if no other editor is specified.

WordStar 3.2, the IBM Personal Editor, and VEDIT 1.34 all performed on the PCM program without any difficulties. Emerging Technology's EDIX 2.0 loaded and ran with no trouble, but the hand-off of the file name from PCM was not entirely smooth. With the EDIX program, the editing function must

> *PCM operates in the PC-DOS 2.1 environment so that it may work on all current IBM PCs, including PCjr. The necessary DOS 2.1 files are included with the package.*

be selected from the main menu using the normal method. Specifying a file name, however, is not necessary. After EDIX is loaded, the regular commands can be used to begin editing or creating a file.

Electronic Mail/ Unattended Operation

In the unattended mode, PCM can send and receive message and data files. This mode of operation is also entered to address mail items, to examine incoming and outgoing logs and mail items, and to maintain address books. The code for electronic mail is contained in a program file called MCEMAIL.EXE and can be called from the top-level menu. Table 2 is a hierarchical view of the menus and work screens.

Electronic mail is categorized as being in one of three classes: message, text data, and binary data. Message files contain only standard printable characters (including formatting) and may be printed or displayed as is. These are transferred using 7-bit data codes. Data files (text or binary) may contain special characters and usually cannot be printed or displayed without undergoing some processing first. Such files require the use of 8-bit codes during transfers.

Personal Communications Manager uses the concept of an address book consisting of up to 40 mailboxes and 10 mailing lists, each of which may contain from none to all of the mailbox entries in the address book. If this does not provide a sufficient number of entries, additional address books may be created. Each mailbox contains the addressee's name (no more than 25 characters), telephone number (no more than 33 characters), and modem speed. Flexible management of mailboxes and lists is provided.

Outgoing mail items are prepared by a multi-step procedure. First, the text of the item(s) to be sent must be created using the editing function. Then mail headers are prepared by addressing the item(s) to mailboxes, lists, or even specific telephone numbers that may or may not be contained within an address book. The process of addressing mail items also defines the times at which PCM will send each

item to its destination. At any time, the user can review the status of outgoing mail items, print or delete them, or create new items.

Figures 5 through 8 show the sequence of menus and work screens used in handling outgoing mail. Note that the top few lines of the screen always give the present location in the menu structure.

When the send/receive mail option of electronic mail is selected, the program prompts for some items—time to start sending, for example—then goes into the unattended mode. It waits for incoming calls and sends mail items at the times the user indicated in outgoing mail headers. As many as 100 items may be in the outgoing queue.

The send/receive status screen contains a two-line window called the *monitor block* that, during active transmissions, shows the most recent four characters from the incoming and outgoing data streams in order to indicate when messages are being transferred.

Incoming mail items are stored on the disks selected using the configuration form. As items are received, entries are made in the incoming mail log and the message text is saved on disk for later retrieval. The modem speed is automatically adjusted to match that of incoming calls. Received items may be displayed, printed, or deleted using appropriate selections of the examine-log-entry menu and work screen. When an item's log entry is deleted, the text may be either saved or discarded.

Error checking and handling is excellent in PCM. If an item cannot be transferred at the designated time, eight additional attempts are made to send it at 15-minute intervals until the item is either sent or marked *not sent*. Mail that is marked *not sent* can be retried.

The Microcom networking protocol is a very good implementation of the ISO Reference Model for Open System Interconnection. This

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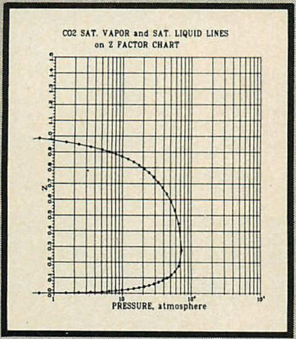

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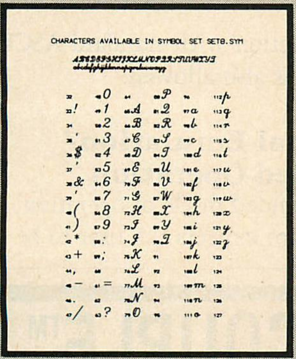

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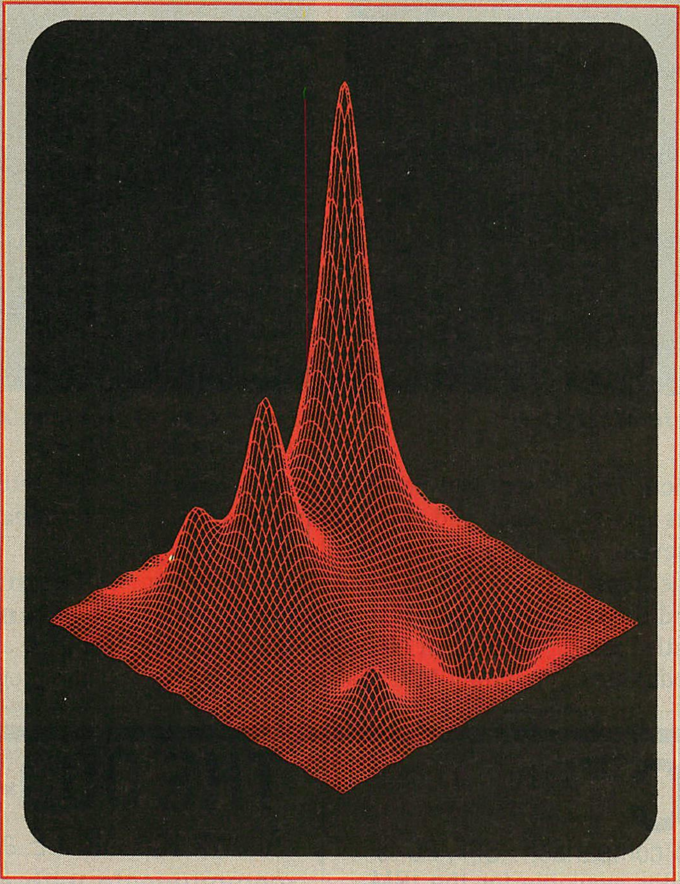

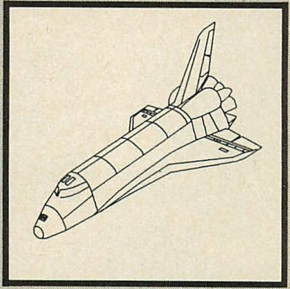

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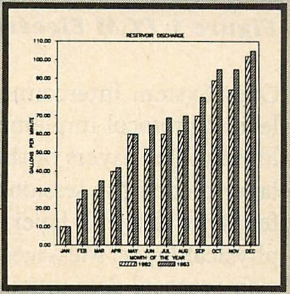
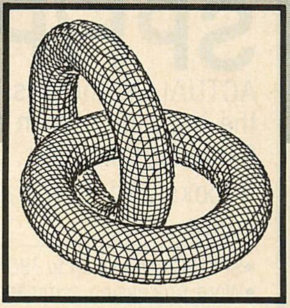
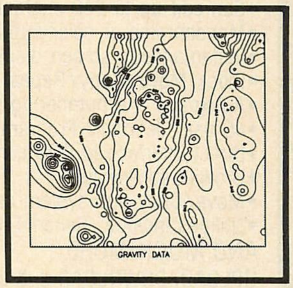


Business Graphics



Program Output



Contouring

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```
                 Electronic Mail

        1. Send/Receive Mail

        2. Review/Address Outgoing Mail

        3. Review Incoming Mail

        4. Address Book Maintenance

Make selection (1-4): [_]
Press Esc to exit
```

Figure 5: PCM Electronic Mail Menu

```
                 Electronic Mail
          Review/Address Outgoing Mail

        1. Address Mail

        2. Review Log

        3. Print Log

        4. Print Mail

        5. Retry Mail Not Sent

        6. Delete Mail Already Sent

        7. Delete All Mail

There are 0 entries in the log

Make selection (1-7): [_]
Press Esc to exit
```

Figure 6: PCM Review/Address Outgoing Mail Menu

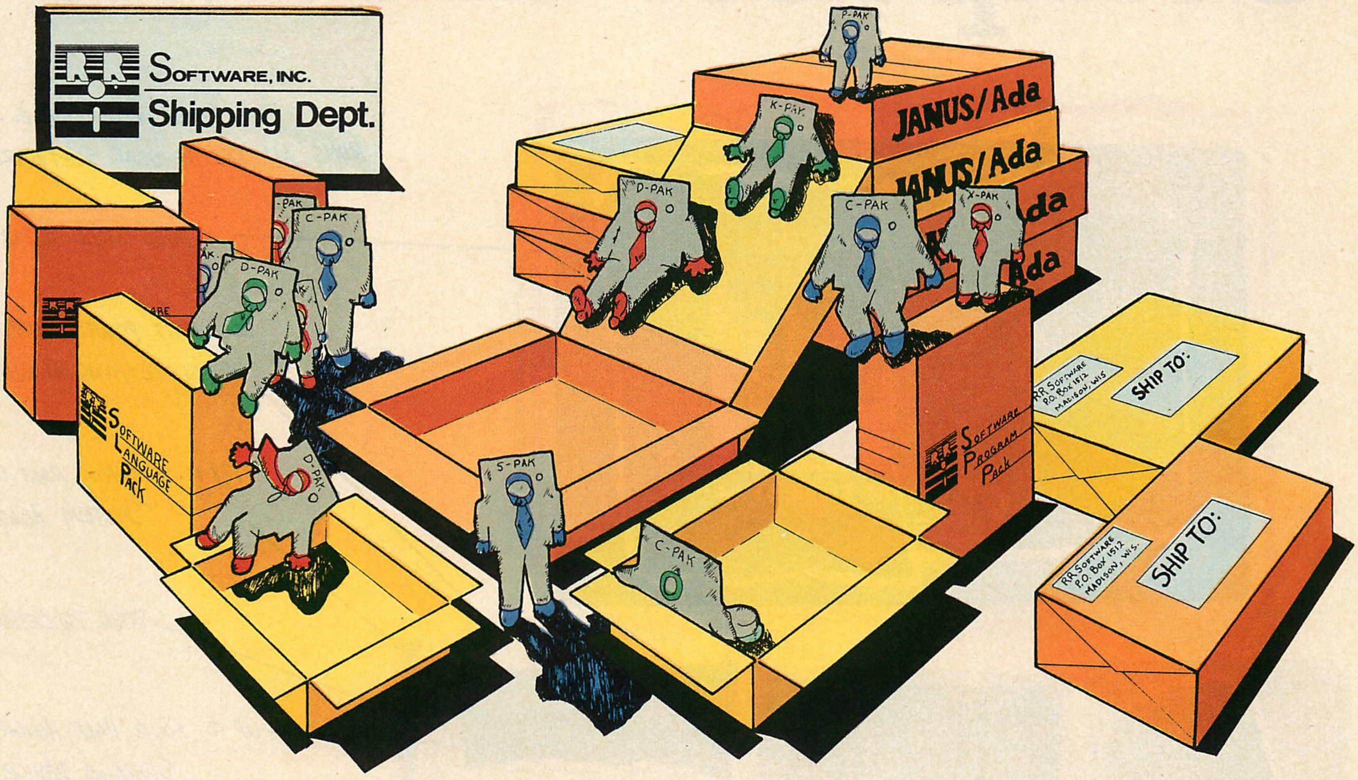
Open System Interconnection. This level-2 protocol implements the lowest three layers of the seven-layer model: the session/file transfer layer, the link layer, and the physical layer. Messages called *session protocol data units (spdu)* are sent between equivalent layers on each end of the communication path to effect the desired transfers.

PCM is compatible with other systems that support level 2 of the Microcom Networking Protocol, including MICRO/Courier, version 2.0. Interaction with standard ASCII terminals is also allowed.

Terminal Emulation/ Attended Operation

In the attended mode of operation, the program expects the user to be

WE'VE GOT YOUR PACKAGE!!



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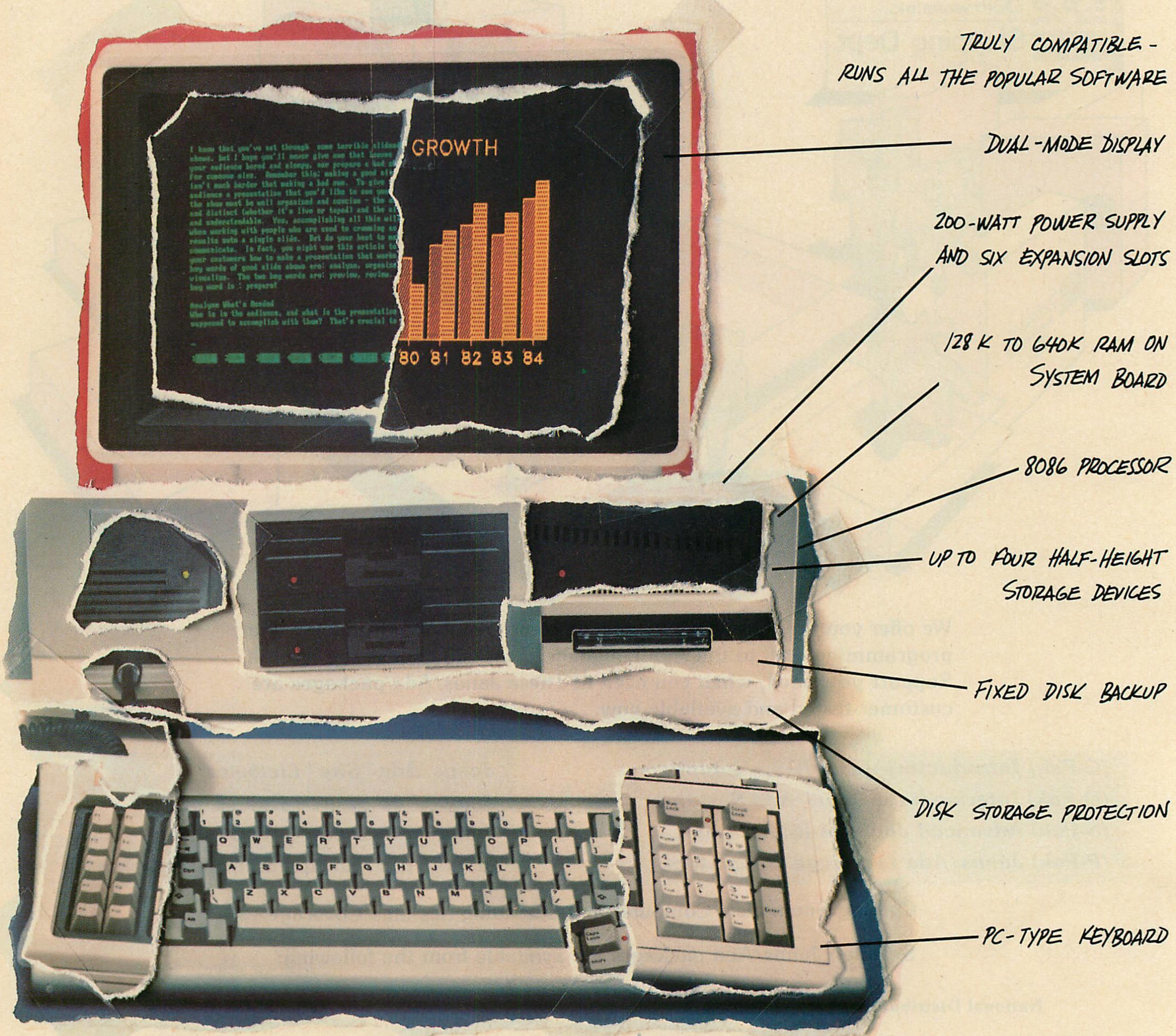

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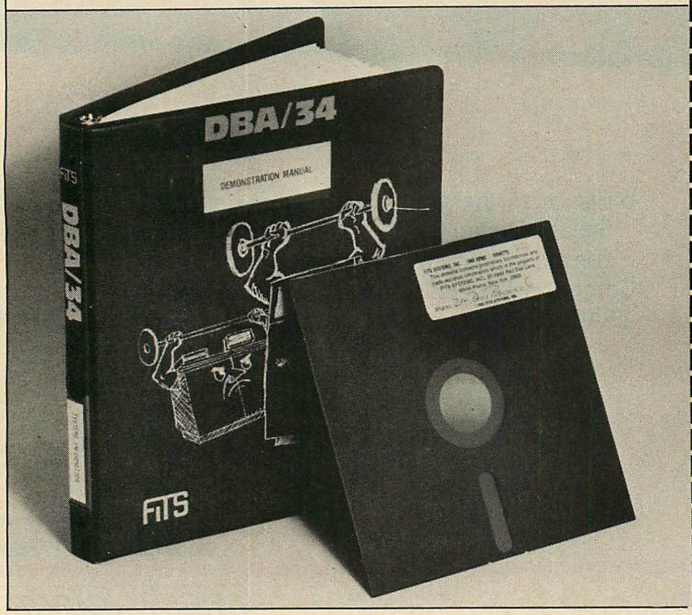

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```
Electronic Mail
Review/Address Outgoing Mail
Address Mail

1. Address Message to Mailbox

2. Address Message to List

3. Address Message to Phone Number

4. Address Data to Mailbox

5. Address Data to List

6. Address Data to Phone Number

7. Display Directory

There are 0 entries in the log

Make selection (1-7): [_]
Press Esc to exit
```

Figure 7: PCM Address Mail Menu

```
Electronic Mail
Review/Address Outgoing Mail
Review Log
Examine Log Entry

1. Display Message Text

2. Print Message Text

3. Delete Log Entry

Status:   to be sent at 01-01-80 00:07

To:       Santa Claus                          Mailbox: <phone>
Tel:      301-333-4444
Subject:  furs, jewelry and Mercedes 280SL

File:     Presents.dat
Class:    Message              Speed: L

Make selection (1-3): [_]
Press Esc to exit
```

Figure 8: PCM Work Screen for Examining Outgoing Mail

in charge of the communications session. The user can send and receive files, storing them on disk if necessary, and print information while it is being received. Menu options also exist for creating (see figure 9), modifying, saving, and printing terminal options lists, called *terminal set-up files*, and for preparation of user functions. The latter capability permits the creation of predefined strings of interactive commands and other characters that may be sent to a remote computer at the press of a function key. As many as 10 user functions may be defined in a terminal set-up file.

User functions lend flexibility to the interactive terminal mode—even without an extensive programming language. Commands and

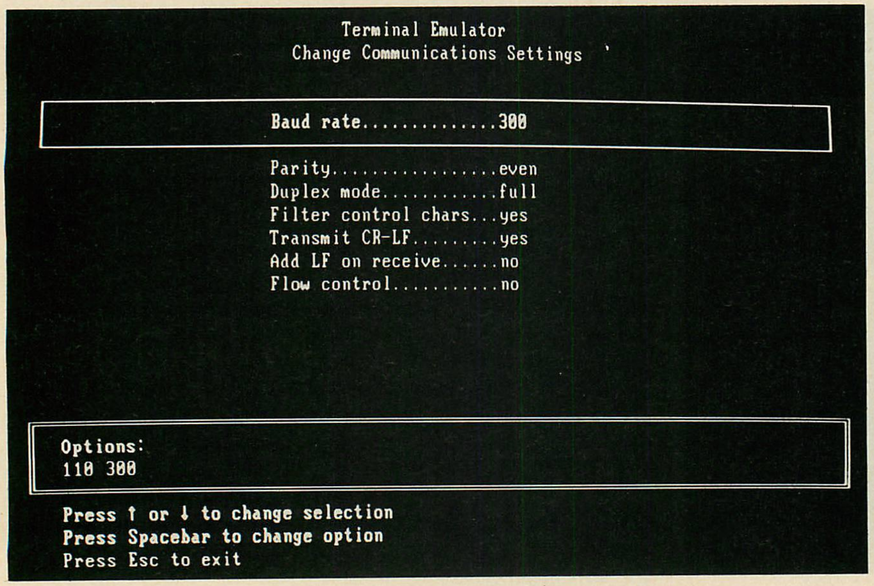

Figure 9: PCM Terminal Emulator Work Screen for Setting Parameters

functions are provided for looping, awaiting specified times and events, matching text strings, and calling other user functions. Table 3 is a summary of available interactive and user function commands for PCM terminal emulation.

Terminal set-up files are provided for Dow Jones, CompuServe, and THE SOURCE. The manual for Personal Communications Manager gives advanced examples of user functions that are extended to provide unattended terminal operation.

The terminal mode uses the local processing and storage capabilities of the PC effectively to handle the "intelligent" functions just described. But is this truly an intelligent terminal emulation? No local editing functions are provided, and no control sequences are assigned to manage the keyboard and display, apart from the usual formatting control codes available on even the dumbest terminals.

Because it does not emulate even one widely used terminal type, PCM cannot be easily identified to a host computer. Therefore, it cannot be used effectively with many application programs that must control cursor positioning and other editing functions. Perhaps this was done deliberately to keep PCM from competing with the IBM 3101 emulation package, a separate communications product sold by IBM.

The Microcom implementation of the RM/OSI networking protocol is very well done. It operated reli-


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ably under a variety of test conditions and worked smoothly with other PCM-equipped systems and standard dumb terminals.

Microcom did a fine job of integrating the use of an external editor into the program. To run PCM on a floppy-only system, the user should choose the smallest editor that suits his needs in order to minimize the time it takes to load it and to reserve as much working space as possible for mail files and related lists.

Command	Description
Alt-A	Switches modem to auto-answer state
Alt-B	Sends a 300-millisecond BREAK signal on the communications line
Alt-C	Clears screen except for status and message areas
Alt-D	Dials phone number; last dialed number, if any, is default; hangs up if no connection is made within 30 seconds
Alt-E	Exits interactive mode of terminal emulator feature
Alt-H	Disconnects phone (hang-up)—requires confirmation
Alt-M	Toggles command state of modem (only applicable to Microcom modem)
Alt-P	Toggles printer on or off
Alt-Q	Displays help in the form of the interactive mode command screen
Alt-R	Starts receive mode for saving incoming text to a file
Alt-T	Waits for a definable time period or until a specified time of day
Alt-W	Wait for any character, for a defined text string, or for a time-delay period to expire; string matches are case-sensitive
Fn	Function key-controlled user functions are sent to the remote computer; ten user functions (F1-F10) per terminal set-up file

Table 3: PCM Terminal Emulation—Interactive and User Function Commands

This is the only situation in which I would deliberately select EDLIN over other editors.

The terminal emulation that is provided is essentially dumb, not intelligent as the manual says. It is adequate for communications with another PCM-equipped system, for use with information utilities, and for reading and writing disk files. It is not too useful with minis and mainframes that run programs requiring complex interactions with the screen and keyboard of a remote terminal. For good terminal emulations (IBM-3101, Televideo 910/920, etc.), try Crosstalk XVI, Icom, or IBM's own 3101 emulator package.

Documentation

The documentation for both ACS and PCM is up to IBM's usual high standards for appearance and packaging. Both manuals are well organized, and coverage of most topics is good to excellent. IBM decided, with good reason, to eliminate from the ACS manual the diagram that purported to explain ACS 1.0 functions, as well as the chapter on the operation and use of the base (machine-language) program. The now-deleted information probably confused more of the product's users than it helped. I mourn the loss of the base program documentation, however, because ACS is a program that demands enhancements, and information on the base program is vital to programmers who want to take up the challenge.

Appendix F of the PCM manual contains a high-level description of the networking protocol used in the electronic mail portion of the program. It is worthwhile reading for those interested in the magic that goes on behind the scenes during unattended file transfers.

The Good and the Bad

The ACS package is handy for communications with IBM mainframe computers. It was originally designed to serve the needs of users in

that environment and this latest version continues that strong bias. It is a poor choice for general and personal use because it is handicapped by limited file-transfer and terminal capabilities. Several low-cost and free programs are available that are far more suited than ACS to communications with information utilities, bulletin boards, and non-IBM hosts. ACS seems to have grown up out of a series of unrelated events. The result is a package that lacks coordination among its main features and that makes its user work too hard to do simple tasks.

PCM, on the other hand, is a well designed and implemented set of programs that offers operating conveniences to individuals and corporations alike. It has very strong electronic mail features. Although, like ACS, it is menu driven, PCM is pleasant to use and flows more smoothly from one frame to the next than ACS. In addition, its work screens are easy to use. PCM suffers from a very limited terminal emulation, but owing to its secondary importance to the whole package, this is not a serious limitation.

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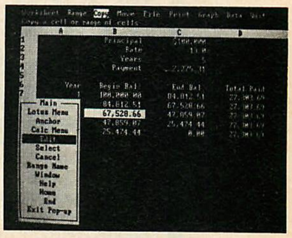

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CIRCLE NO. 181 ON READER SERVICE CARD

Go for Broker

How to protect yourself if you choose to use a broker

MAX STUL OPPENHEIMER

Becoming very, very rich requires only two steps: Write a very, very good program for those throngs of first-time computer buyers (note: the definition of "good" is flexible); sell very, very many copies of the program.

It has been eight months since I explained the options for protecting the rights to your software. Last month I explained how to keep those rights while negotiating a consulting contract. Are you rich yet? If not, don't give up.

Writing a commercially valuable program is difficult. Commercializing such a program is hard, too. Getting from step one to step two can be downright dangerous.

In this age of specialization, there is no reason that a good programmer should also be good at marketing. It may make sense to turn to a specialist. However, if you have looked longingly at those ads that offer to market your program for you, be advised that unless (and even if) you take some preliminary steps, you may be risking some rights by sending in your program.

You may recall from prior columns that you obtain some protection for your copyrightable work simply by the act of "fixing" it in some tangible medium. Traditionally, this was done by writing it on paper, but the chances are good that recording it on a disk or burning it into a ROM chip will serve. This gives you at least threshold copyright protection for your program. You do not have copyright protection for your concept, or for a program that incorporates all of your good ideas but expresses them differently. There is also the possibility that, if your program is the unique way to accomplish its purpose, you have no copyright protection at all. Refer to "The Basic Tools of U.S. International Property Law" (November/December 1983, p. 213) and "Disputing the Rights to Custom-Designed Software" (July 1984, p. 185) for more details.

In any event, you will probably want more than threshold copyright protection for your initial encounter with commercial software marketing. Before you deal with the difficult issues relating to protection of property rights, there are several simple bargaining points that should be agreed upon. Begin by asking questions.

What will the software broker do for you? Some propose to seek buyers actively; others will do no more than list the availability of your program on their data base.

What will he charge you and when? A fixed fee, a share of sales or profits, a fixed commission per sale, or some combination of these? How do you compute profits? (Do you deduct the cost of your computer?) Does he pick up the expenses pending the first sale? How much does he plan to spend?

Does the broker insist on the exclusive rights to market your program? If so, for how long, and do you have any right to terminate the relationship? A broker may work harder if he has the exclusive rights, since he will be assured the benefit of every sale. On the other hand, shouldn't he produce sales in order to keep the exclusive rights? Remember that once you have granted exclusive rights, you have given up most of your bargaining power—the broker ought not to be able to sit back and wait for lightning to strike (after all, you could do that yourself).

These points are between you and the broker. The harder negotiating points involve protecting yourself from actions the broker might take that will affect your rights vis-á-vis third parties.

Normally, a broker will act as your agent. The limits of his authority as your agent should be agreed upon between you. He should report to you occasionally on his progress. There should be agreement on what he can do on your behalf in terms of pricing and other sale-related decisions. Perhaps he should do no more than find a potential market and let you do the negotiating over price, credit, returns policy, and so forth, or perhaps you would prefer that he han-

Max Stul Oppenheimer is a partner in the Baltimore law firm of Venable, Baetjer, and Howard.

dle those details. In any event, at some point you should have the final say on whether to accept the buyer he has found. (The broker might legitimately ask that you be reasonable in making that decision, or that you pay him something if you reject a perfectly good deal on a whim.) Agree on who has the final say about whether there is a deal.

Once you and your broker have reached an agreement on the limits of each other's authority, you must take one further step. A legal concept known as "apparent authority" protects innocent third parties dealing with an agent. The broker will be presenting himself as your agent, and he will have a copy of your software and a contract. A third party who does not know the limits of an agent's authority may assume that the agent has the authority such agents normally have.

This general statement of the law raises fascinating legal issues: What type of authority do software brokers normally have? Can they waive copyrights? Can they authorize reverse-engineering object code? Can they make decisions on backup policies? Can they give warranties? I don't know. Try to avoid finding out. Remember that a third party can assume that an agent has authority only if he is not on notice to the contrary: put him on notice.

For example, build a title screen into your program that says, "This program is my property. I have the copyright and the trademark. My broker has possession, but not ownership, of a copy of the program solely to try to find a customer for me. He's a nice person, but the final decision on whether to sell it is mine. My broker has no authority to do anything except demonstrate the program. He can't authorize listing it, copying it, modifying it, or anything else. I'm not sure it works, so he certainly can't make any warranties. If he promises you anything, you'd best check with me first. Here's my phone number." You and your broker can work out the actual language.

If you have a trademark (and remember that in most states you can appropriate one simply by using it in commerce with the intent to appropriate it), put it everywhere you can—on the documentation, on the program title page, salted throughout the code, on the diskette jacket, on your broker's jacket—and remember to use the symbol "TM" unless it has been federally registered (in which case use the symbol ®). Make the broker promise not to obliterate it when he presents your program. Similarly, use a copyright notice. Unless you have taken further steps, protection stops at the border—find out if your broker plans to show your program abroad and if so, take care of the necessary filings.

In discussing the terms of your agreement with the broker, remember that the broker is taking some risks, too. The economic risks are obvious. (Is he spending his own money? Enough to give him the right to call some of the shots?) Suppose, in return for helping you establish your name in the software pantheon, the broker asks for the right to market any enhancements of your program (or your next program, or any program you write in the future). Once you get over being very flattered, you should think about whether you want to tie up your entire career at this point.

Some of the broker's risks are less obvious: do not be offended if he asks you to warrant that you are the author of the work. His annoyance would be justifiable if he signed a multi-million dollar contract, and you could not perform because you did not write the program. It would even be reasonable for the broker to ask that you indemnify him against any claims of copyright infringement. Imagine his embarrassment if he should try to sell your program to the person who actually wrote it.

LEGAL BRIEF

A little distrust on both sides is healthy: it helps define the relationship. Negotiation concerning the risks—the author's fear that the broker will steal his idea or the broker's fear that the author will claim that the broker stole a program—is difficult. The broker may open negotiations with the following:

"Author acknowledges that Broker is dealing with many other authors, all of whom have wonderful new ideas. Since there are a limited number of wonderful new ideas, chances are that there is some duplication. Broker is an honorable man, so if he markets something similar to Author's program, it is because someone else had the same idea or because Broker developed it independently. In case of a tie, Broker's decision as to the winner will be final. Author hereby waives any claims against Broker for infringement of copyright, trade secrets, or patent rights. Author hereby agrees never to sue Broker for anything."

You might counter with:

"This program is the property of and copyrighted by Author. It is unpublished and contains valuable trade secrets. Only the Author and Broker have seen it, so if it shows up on the market, we know who's responsible. Broker will take all steps necessary to keep the program confidential and, if he fails to do so, will pay Author the royalties he should have earned plus attorneys' fees. Broker hereby acknowledges Author's rights and agrees not to contest them in any proceeding."

Suppose the broker responds, "How can I market your program if I can't show it to anyone, and how can I show it to anyone at the risk of being liable for the enormous damages if, through no fault of mine, someone else markets a similar program? Besides, that's the ninth combination spreadsheet-food processor program I've been offered today, and I understand that one is already on the market in California under the name Avocado Spread."

Time to look for some middle ground. One approach would be for you, as the author, to make a preliminary, unprotected, disclosure of the general nature of the program (use your imagination) and to ask that the broker identify any areas of similarity to other programs on the market or under his consideration. Depending on the broker's response, a more focused confidentiality agreement might be constructed, specifying what particular aspects of the program are, in fact, unique. The demonstration version of the program might be supplied in incomplete form, and the broker might be asked to agree not to decompile, modify, or otherwise pry into the program himself and not to allow any potential customer to do so. Perhaps the broker would be willing to agree to take "reasonable" steps to keep the software confidential, or to take such steps as he would if the software were his.

Return to the real world for a moment. What if you are a programmer who hasn't sold a thing since the lemonade bankruptcy in third grade? What can you realistically hope to accomplish before you sign a boilerplate brokerage agreement? You certainly can affix copyright and trademark notices. You can satisfy yourself that this broker is a reasonably honest, reasonably competent person. You can try to get significant promises reflected in a written agreement (and be suitably suspicious if you cannot). Finally, you can communicate your expectations to the broker and try very, very hard to leave yourself a cheap way out if the broker does not produce the results you expect.

If you cannot get a satisfactory agreement, you can always keep the program for your own private enjoyment or, if you are really cautious, degauss the program disk and turn off the computer.

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The B.O.S.S. handles business oriented data files with thousands of records as well as it handles small files. Sorting rarely is needed — The B.O.S.S. updates all indexes (up to 15) when changes are made.

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■ Versatile, Powerful and Portable
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- A powerful, fast **sort** capability.

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Menu driven	Yes	No	Yes	Yes	Yes
Files open on line	8	2	N/A	2	1
Maximum records/file	100,000,000	65,600	32,800	32,800	32,800
Maximum bytes/record	10,000	1,000	2,400	1,000	255
User must be programmer	No	Yes	No	No	No
Maximum number of indexes automatically updated.	15	1	1	1	1

(Data are taken from most recent versions of programs available to American Planning Corporation, Alexandria, VA)

■ Advanced Features
Experienced analysts and programmers use all levels to create sophisticated business application programs.

The B.O.S.S. provides analysts and programmers with a broad and varied set of functions patterned after mainframe software development tools. Large and complex programs are created easily and in record time.

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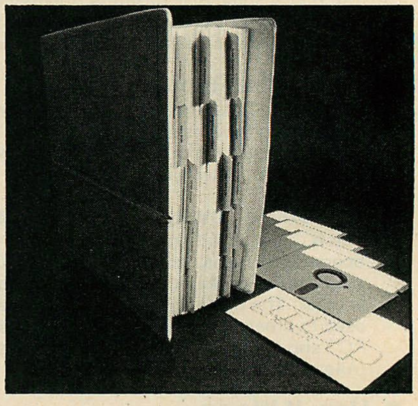

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Execution time ratio

mbp COBOL	Level II** COBOL	R-M*** COBOL	Microsoft**** COBOL
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128K system with hard disk required. *IBM/PC is an IBM TM; **Level II is a Micro Focus TM; ***A Ryan-McFarland TM; **** A Microsoft TM.

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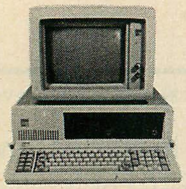

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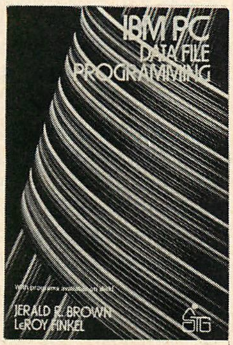

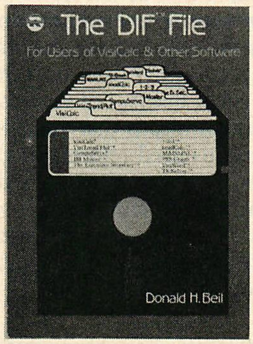

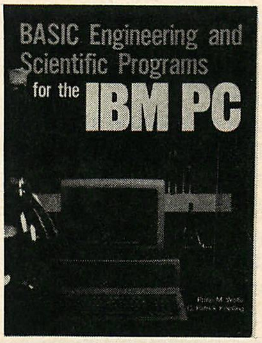

IBM PC Data File Programming
Jerald R. Brown and LeRoy Finkel
(John Wiley & Sons, New York, 1983)
367 pages, paper, $14.95

IBM PC Data File Programming is a well-written instruction manual for the creation, modification, and use of data files from IBM PC BASIC. Data files using both sequential and random organization are covered. Although the book is intended for novice programmers who have had some BASIC programming experience, it is also an excellent resource for programmers experienced in other languages, such as FORTRAN or COBOL, who must learn to program in BASIC.

The book emphasizes the importance of programming style and begins with a clear description of the techniques programmers should use to be sure their programs are well designed, easy for others to understand, and as compatible with other versions of BASIC as possible. These concepts are kept in mind throughout the book; the sample programs adhere to them and, when a choice must be made between style and efficiency or portability, the authors comment on their choice.

The second and third chapters are a review of BASIC statements and a short tutorial on the building of data entry and error-checking routines. The statements review focuses on those used to input and manipulate data (e.g., LINE INPUT, MID$). Some fundamental programming necessities, such as IF . . . THEN statements and subroutines, are also reviewed.

Once they have covered procedures for ensuring that information has been properly entered, is of the proper type, and falls within the proper range, the authors discuss techniques for making sure that the data are entered and displayed in the desired format.

The fourth chapter of *IBM PC Data File Programming* introduces the concept of data files, beginning with sequential data files. Through a series of example programs and self-testing exercises, the reader is shown how to initiate a file with the open statement; how to tell the computer whether it is an input, output, or existing file to which data are to be added; and how to read information from or write information to the file. The authors discuss methods of copying information from one sequential data file to another, correcting information on a sequential data file, and merging the information from two sequential data files.

Last to be covered are the random access files. Their treatment is similar to that given the sequential files; through a series of example programs and exercises, the reader can learn to develop programs that read, modify, or create random access data files.

The book proceeds at a good pace, with exercises and example programs that gradually increase in their level of complexity. The reader is given programming exercises for each phase of instruction, and the authors have provided answers for all the exercises. This in itself would make the book worth buying, but the authors have done even more: the example programs are practical routines that can either be used as they are or expanded to suit the individual requirements of the reader.

Some of the programs provided are: a form-letter program that accepts addresses from an address data file; a program to read, display, and provide the option to modify the contents of either sequential or random access data files; an inventory control program; and a personal money management program. These programs are also available on a disk ($19.95) for those who do not wish to enter them manually.

—MARILYN V. FLEMING

The DIF File: For Users of VisiCalc and Other Software
Donald H. Bell
Reston Publishing Company; Reston, VA; 1983
235 pages, $15.95 paper, $19.95 cloth

The *data interchange format* (DIF) was developed by Robert M. Frankston, president of Software Arts, Inc. (the creators of VisiCalc) as a way of enabling data communication between VisiCalc and other software packages. The format can be used to organize data on any storage device and, because it is a concept rather than a product, it is essentially hardware independent.

The purpose of this book is to explain the process of exchanging data via DIF files. People who are interested in understanding DIF files, possible applications for this concept, and data exchange between different software programs will find this book useful.

The steps involved to create a data file from one program and read it into another are presented, with an emphasis on the concept that the common data format is only a part of the process. The procedure of moving data from one program to another is presented as a multi-step process in which each step must be performed carefully.

Guidelines are offered for those who wish to exchange data between software products; a chapter is devoted to documentation of the exchange process. The author presents actual examples of data exchange between: VisiCalc and VisiTrend/Plot; VisiCalc and PFS:Graph; DB Master and The Executive Secretary; VisiWord and VisiCalc via LoadCalc; CompuServe and VisiCalc using MAINLINE; DIF files and 1-2-3; and DIF files and TK!Solver.

In addition, there is a tutorial on the DIF format, a section on the DIF Technical Specifications from Software Arts, a discussion of references in other

books to listings of BASIC and Pascal programs that process DIF files, and a limited annotated listing of commercial software that is capable of using data files in the DIF format.

The author also correctly points out many of the DIF format limitations, including the fact that the DIF format is designed for numeric data and is awkward or unusable when transferring both numeric and nonnumeric data. Also mentioned are the problems with unusual data that do not fit, such as VisiCalc's repeating label. The author also discusses the requirement that data must be rectangular (that is, it must have an equal number of records and fields), which means that variable-length records need reformatting.

Another problem mentioned here is that only labels and values, not formulas and formats associated with data entry, are stored. Finally, the author touches on the fact that the DIF format is not the universal standard for data interchange. Different programs that create DIF files do not always create the same DIF file from the same data.

This book is well written, easy to read, and easy to understand. The author has attempted to explain the DIF files process and the steps necessary to make it work for the user. Although much of the book is devoted to VisiCalc file transfers, the material presented should also be helpful to people who have other forms of spreadsheets, such as MultiPlan and SuperCalc, that use variations of the DIF format.

The DIF File is recommended for anyone who is concerned with data transfer between different software programs and anyone who is interested in the subject of DIF files and their use.

—JAMES E. CREWS

Basic Engineering and Scientific Programs for the IBM PC
Wolfe and Koelling
(Brady; Bowie, MD; 1983)
358 pages, paper, $19.95

This is one of Brady Publishing Company's newest texts aimed at the IBM PC and XT market. The book contains many useful topics and programs for the engineering-scientific community, as well as an optional diskette containing all of the programs in the book (38 major subroutines and programs). Like most books published by Brady, this one is easy to read, accurate, and has plenty of appropriate examples.

The book is divided into 15 major sections, covering the IBM Personal Computer, data reduction, matrices and vectors, curve fitting with linear regression, solving simultaneous linear equations, roots of polynomials, numerical integration, numerical solutions to differential equations, linear programming, forecasting with exponential smoothing, project planning and scheduling with CPM (Critical Path Method), sorting, disk data files, data structures, and random numbers and simulation.

One of the features I like about this book when compared to other books for scientists and engineers is that it is not just a collection of programs, but an actual textbook that teaches theory, gives practical examples, and then provides a program to solve those examples. This approach helps readers expand their horizons into applications that may never have occurred to them before. Another technique the authors use is that of progressive examples, each example building upon the one before

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as a chapter progresses. The second chapter, on data reduction, will serve to illustrate both of these points.

Initially, chapter 2 appears to be a standard treatment of simple statistical concepts, such as mean, median, mode, range, variance, and standard deviation. Indeed, the text does teach these concepts clearly, presenting several examples. However, before a simple statistical program can be written, the authors suggest the need for plotting the data, which immediately requires knowledge of concepts such as sorting and scaling. The main program is created first, and these additional topics are brought into that program as subroutines. The plotting routines in the main program use the text screen for displaying the results and therefore will work on both the monochrome and color graphics screens. The chapter ends with some examples to help the reader verify and debug his program once it is entered.

Chapter 3 is a more or less standard treatment of matrices and vectors, with examples of how to transpose, add, subtract, multiply, and perform exponentiation. Chapter 4 is an outstanding treatment of curve fitting with linear regression. Topics such as simple linear regression, multiple regression, and stepwise regression are presented in examples and in two programs. The simple linear regression program teaches the fundamentals of regression techniques, while the multiple and stepwise regression program will form the foundation of a powerful analysis tool. Many different examples are included in this chapter to help the reader envision possible applications in his work.

Chapters 5 through 8 also deal with conventional topics, such as solving linear equations, finding the roots of polynomials, performing numerical integration, and finding numerical solutions for differential equations. Of all of these chapters—indeed, of the whole book—chapter 8 ("Numerical Solutions to Differential Equations") is the most disappointing. There is such potential in this chapter to give excellent engineering and scientific applications, and the authors drop the ball. There is not one example that is taken directly from an engineering or scientific application. Rather, all examples remind me of a purely mathematical approach to differential equations: "Example #2 Solve the following differential equation using the Runge-Kutta formula from equation (7) at x=0.2 and h=0.2."

Does this sound like engineering? Does this sound like fun? The closest they come to redemption in this chapter is to include two problems for the reader to solve, one dealing with a classical liquid mixture question and one dealing with radioactive decay.

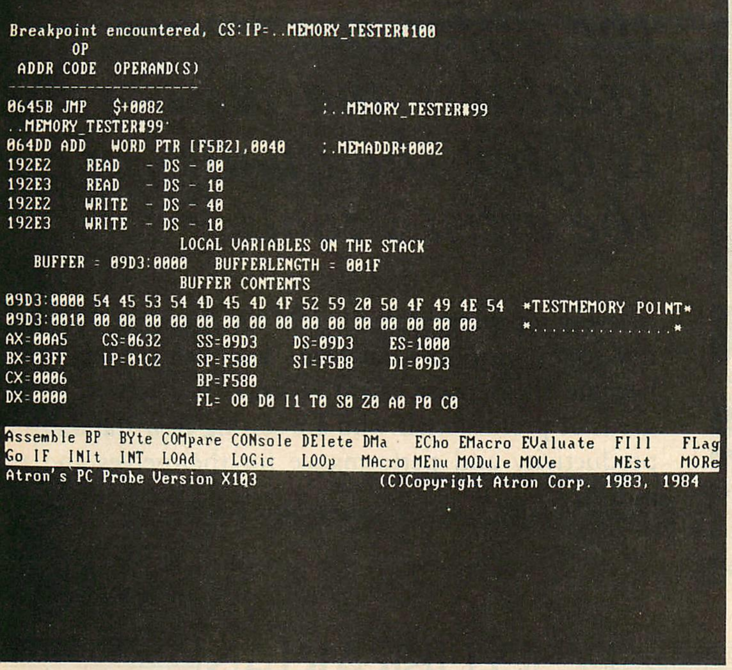
Chapters 9 and 10 are well written. Chapter 9 presents the concepts and definitions of linear programming. The material suggests how to formulate a problem and offers the traditional graphical and linear algebra solutions before discussing the Simplex method of solution. The remainder of the chapter describes how to use the 350-line Simplex program and provides many practical examples. Chapter 10 returns to graphing techniques and suggests several methods for exponential smoothing of data. This topic is presented with the anticipation of being able to project or forecast future trends based on previously collected data.

Chapter 11 is devoted to CPM (Critical Path Method). This technique is used for project planning and scheduling. While the topic is interesting, it probably should have been included in a book for managers, not engineers.

The remaining four chapters cover sorting techniques, disk data files, data structures, and random numbers (used for simulation). The topic of data structures is probably a new concept for engineers and scientists. The authors correctly point out that when large amounts of data are to be handled, the data structure can dramatically affect execution time. Concepts for handling data such as stacks, queues, linked lists, and bidirectional lists are presented, along with examples and programs. Again, these programs can be used as main programs or as subroutines.

This text will not be disappointing for persons seeking engineering and scientific methods of handling data. The authors present their subject matter clearly and concisely.

—WILLIAM H. MURRAY



ATRON Announces A State of the Art Advance in Software Debugging—PC Probe

PROGRAMMERS AND MANAGERS know that finding bugs during new product development and over the entire product life cycle adds up to a significant portion of total product deelopment cost and support time. Investing in the right debugging tools will greatly improve time to market as well as minimize development cost. Atron Corp. has the right debugging tools for the PC environment. These are:

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atron

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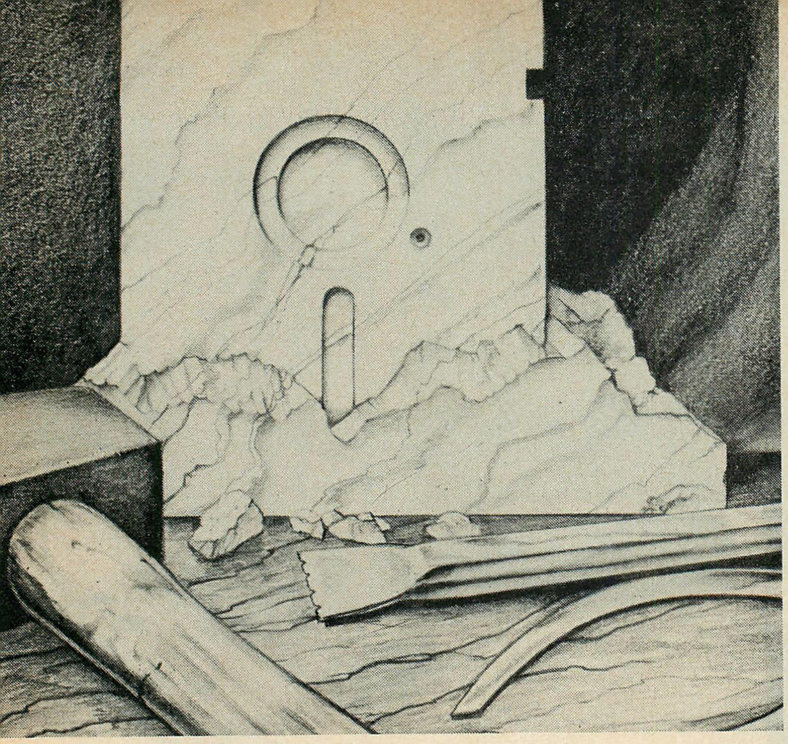
CIRCLE NO. 107 ON READER SERVICE CARD



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An Unsolicited Comment from
Steve Kauffman
Consulting Engineer

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TECH RELEASES

Hardware, software, and other developments for the PC

Hercules Color Card

HARDWARE

IBM has announced **price reductions** on many of its products. First, less expensive versions of the PC and PC/XT have been introduced. These new machines come with 256K memory and one 360K disk drive. A typical configuration consisting of a new 256K version PC, one 360K disk drive and adapter, and a monochrome display and adapter costs $2,520, a reduction of 23 percent. A new XT with 256K and a monochrome display and adapter now costs $4,920, a reduction of 18 percent.

Other reductions were in the price of the Portable PC ($2,595) and the PC*jr* (entry model—$599; 128K model—$999). In addition, a new version of the Portable PC with two factory-installed disk drives has been introduced ($3,020). The price for other PC system units has been lowered as much as 23 percent, and new, lower prices are also in effect for many PC options.

IBM
Entry Systems Division
P.O. Box 2989
Delray Beach, FL 33444
305-241-7614

CIRCLE 460 ON READER SERVICE CARD

A color graphics card for the PC and XT is now available from **Hercules Computer Technology**. The company claims that its **Hercules Color Card** matches the performance of the IBM Graphics Monitor/Adapter card and even offers a parallel printer port not found on the IBM product—all for $1 more than the IBM card. The Hercules Color Card is one-half the size of the IBM card and can fit into one of the XT's short expansion slots. The size reduction was made possible by advanced gate array technology. The Hercules card is compatible with all color graphics software for the IBM card. $245.

Hercules Computer Technology
2550 Ninth Street
Berkeley, CA 94710
415-540-6000

CIRCLE 484 ON READER SERVICE CARD

A lightpen that functions on both IBM's monochrome and color displays has been developed by **The Lite-Pen Company, Inc.** The product, called the **Lite-Pen System**, talks directly to the computer through the CRT when the pen touches the screen. In addition to the Lite-Pen itself, the company is offering eight software programs to be sold with the pen, and plans to introduce some overlay programs that will enhance current systems, including Lotus 1-2-3 and WordStar. The Lite-Pen is made of anti-slip stainless steel. It self-compensates for screen intensities and maintains a one-dot resolution. The package comes with a small, four-conductor I/O cable that connects to the computer. $295.

The Lite-Pen Company
P.O. Box 45255
Los Angeles, CA 90045
213-670-8658

CIRCLE 498 ON READER SERVICE CARD

The recently announced **Cabling System** from **IBM** is designed to reduce the complexity and cost of installing or moving computers within a building. To be available in October 1984, the system is similar to telephone lines, with connections made to outlet plates in office walls. The outlets are connected by cable to a distribution panel located in a wiring closet. A panel can accept up to 64 cables. Two devices can be connected with patch cables at the closets where the cables converge. If a computer is moved from one room to another, it is plugged into the wall outlet at its new location and the patch cable in the wiring closet is reconnected. In conjunction with the new cabling system, IBM also announced a local area network, to be implemented in two to three years, that would enable computers, workstations, and other devices to share resources and exchange information.

IBM
Information Systems Group
900 King Street
Rye Brook, NY 10573
914-934-4829

CIRCLE 486 ON READER SERVICE CARD

The IBM Cabling System

Genius VHR

A new full-page display has been designed for the IBM PC and compatibles by **Micro Display Systems, Inc.** Called the **Genius VHR** (for very high resolution), the monitor is 15 inches high with a density of 720 by 990 pixels. The user can select a full page either with the traditional 25-line mode or with 66 lines. The Genius VHR has a tilt-screen and is available in amber, green, or white phosphor. $1,150.

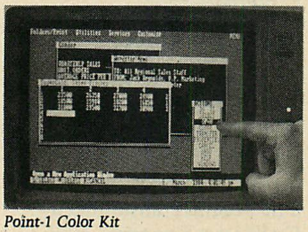
Micro Display Systems
P.O. Box 455
Hastings, MN 55033
612-437-2233

CIRCLE 494 ON READER SERVICE CARD

MicroTouch Systems, Inc. has announced the touch-sensitive **Point-1 Color Kit** for the IBM PC color display monitor. The kit allows color monitors to be equipped with a screen that enables users to select from menus, position the cursor, and create graphics merely by touching the monitor with a fingertip. The touch screen offers a resolution of 1,024 by 1,024 touch points. Accurate manipulation is possible down to single letters. Besides the 13-inch-diagonal touch screen, the kit includes an intelligent controller and RS-232-C serial interface. Installation is done by MicroTouch or a qualified technician. Point-1 Color Kit is fully programmable and is supported by software development tools. OEM price: $650; unit price: $1,045.

MicroTouch Systems, Inc.
400 W. Cummings Park
Woburn, MA 01801
617-935-0080

CIRCLE 496 ON READER SERVICE CARD



Point-1 Color Kit

Two new monitors are now available from **Princeton Graphic Systems**. They are the **MAX-12**, a monochrome monitor with amber phosphor; and the **SR-12**, a high-resolution RGB color monitor. The MAX-12 delivers 900-by-350 resolution and features dynamic focusing circuitry, which ensures sharpness from the center to the edges and corners. The SR-12 has 690 horizontal and 480 vertical resolution that is achieved without using interlace technology. The result is an image without flickering, suitable for both word processing and graphics. An interface card is required to support the resolution generated by the SR-12. Princeton Graphic Systems markets the Scan-Doubler interface card for an additional $249. Prices: MAX-12, $249; SR-12, $799.

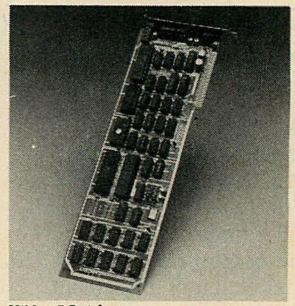
Princeton Graphic Systems
1101-I State Road
Princeton, NJ 08540
800-221-1490
609-683-1660

CIRCLE 490 ON READER SERVICE CARD

The HiNet/PC Adapter from **Digital Microsystems** allows IBM PCs to be a workstation on Digital's HiNet LAN. The adapter adds 64K RAM, a Z80 processor, RS-232-C interface port, and HiNet network interface to its host PC. The HiNet LAN system allows as many as 63 workstations to participate. It can simultaneously support CP/M, CP/M-86, and MS-DOS applications. $495.

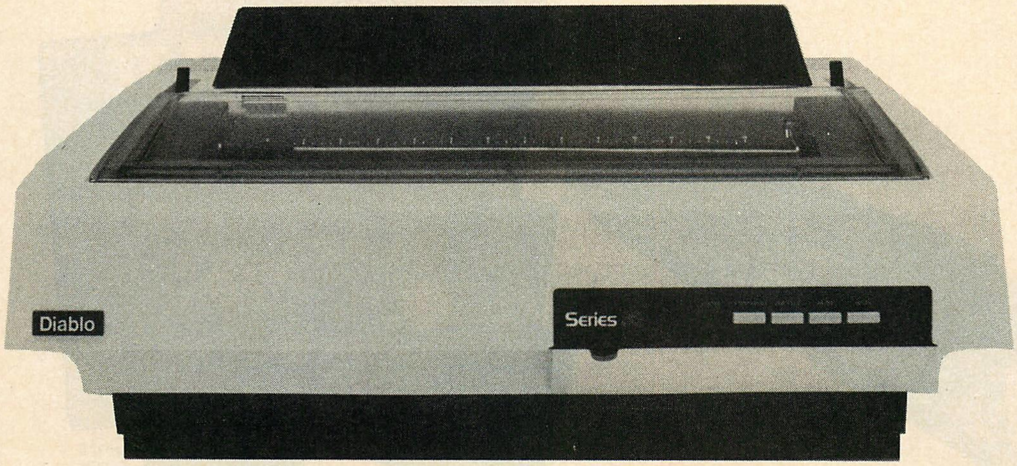
Digital Microsystems
1840 Embarcadero
Oakland, CA 94606
415-261-1034

CIRCLE 489 ON READER SERVICE CARD



HiNet/PC Adapter

Avatar Technologies, Inc. has a new protocol converter that allows PCs to emulate IBM 3278/79 terminals. The **PA100** offers help screens and single-key switching between PC and terminal operation, with screen buffers to retain information from the mainframe environment when a user switches to PC mode. Multilevel security prevents unauthorized access to mainframe data base files. Avatar also has introduced the **PA100E**,



Diablo Systems' Series 36

which allows any PC or ASCII terminal to access IBM mainframe environments and ASCII hosts. Like the PA100, the PA100E features help screens, the ability to switch between the minicomputer and IBM mainframe environments and the PC mode, and multilevel security. For remote applications, the PA100E has a disconnect feature designed to prevent modem tie-ups. Prices: PA100, $895; PA100E, $1,095.

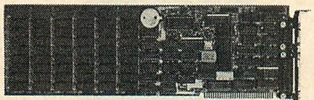
Avatar Technologies, Inc.
99 South Street
Hopkinton, MA 01748
617-435-6872

CIRCLE 487 ON READER SERVICE CARD

IDE Associates has introduced a plug-in multifunction card with from 64K to 384K memory for the IBM PC and XT. **IDEAmax 384** allows cabling of both serial and parallel interfaces, enabling the computer to interface printers, disks, and communications devices. The product uses a four-layer design that has better noise immunity than two-layer designs. Optional features include serial interface, parallel interface, clock/calendar, and a game port. Every IDEAmax 384 comes with software for RAMFloppy disk emulation, real-time clock, parallel printer selection, print spooler, and diagnostic. Additional memory and options can be added later. Prices range from $320 for 64K memory and one option to $795 for 384K and four options.

IDE Associates
7 Oak Park Drive
Bedford, MA 01730
617-275-4430

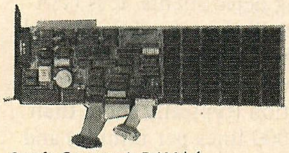
CIRCLE 493 ON READER SERVICE CARD


IDEAmax 384

Also introducing a multifunction card is **Seattle Computer**. Its card for the IBM PC and PC/XT is the **RAM+6**, which allows up to 384K additional RAM. Features include a clock/calendar, RS-232-C serial port, parallel port and game port. Also provided with RAM+6 is FLASH DISK software, which speeds up certain disk operations, and FLASH PRINT software, enabling the printer to run at the same time the computer is being used. Seattle has 64K expansion kits. Prices begin at $395 for 64K memory.

Seattle Computer
1114 Industry Drive
Seattle, WA 98188
206-575-1830

CIRCLE 492 ON READER SERVICE CARD


Seattle Computer's RAM+6

Diablo Systems, Inc. has a new daisywheel printer known as the **Series 36**. The printer runs at 30-40 cps and includes Diablo's All Purpose Interface with RS-232-C, IEEE 488, and Centronics. A 12-bit parallel interface is available, making the printer compatible with most computers. Accessories for the Series 36 include single-bin electronic and mechanical sheet feeders and a bidirectional tractor for graphics. The printwheel library has 18 languages and 19 type styles. $1,595.

Diablo Systems, Inc.
24500 Industrial Blvd.
Hayward, CA 94545
415-498-7000

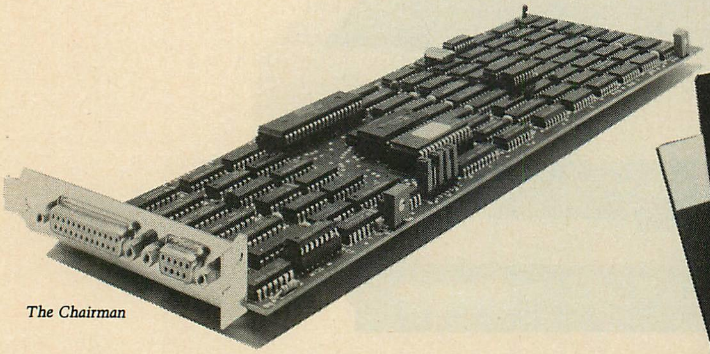
CIRCLE 491 ON READER SERVICE CARD

An auxiliary cooling system is available from **Analytic Information Processing (AIP)** to help lower the temperature in a PC or XT when expansion cards or hard disk drives are used. **PCool** is said to drop a PC's temperature an average of 15 degrees Fahrenheit by providing an intake air flow directly across the expansion cards. It is supposed to break up hot spots by developing turbulence. $99.95.

AIP
P.O. Box 966
Danville, CA 94526
415-837-2803

CIRCLE 483 ON READER SERVICE CARD

Hicomp Computer Corporation is manufacturing a bubble memory board for the PC and XT. **Bubble Drive** offers either 256K or 512K of nonvolatile, high-speed mass storage on a single card that plugs into any I/O slot. It functions as a floppy disk and is compatible with PC DOS 1.1 and 2.0. No hardware or software modifications are necessary. Standard features of the Bubble Drive are the write-protect and boot-enable switches and a



The Chairman

Level II COBOL

self-installing feature that automatically installs the Bubble Drive software after power-up. Available as an option is an RS-232-C port. Prices: 256K version, $995; 512K version, $1,495.

Hicomp Computer Corp.
5016 148th Avenue NE
Redmond, WA 98052
206-881-6030

CIRCLE 485 ON READER SERVICE CARD

The Chairman, a new graphics board from **Mylex Corporation**, offers graphics enhancements for the PC and XT. Using a single expansion slot, The Chairman combines color or monochrome display options in one board. It allows graphics modes on the monochrome display in four shades of green, or drives the color monitor in 16 colors. The Mylex software diskette that comes with the package provides APL characters and supports the enhancements of The Chairman. $595.

Mylex Corporation
5217 NW 79th Avenue
Miami, FL 33166
305-592-9669

CIRCLE 495 ON READER SERVICE CARD

SOFTWARE

Micro Focus has introduced the **High Performance Level II COBOL** compiler for the IBM PC. The new compiler is intended for large corporate and government data processing departments. It is GSA-certified to the Federal High Level ANSI 74 COBOL standard and includes fast compilation (typically more than 1,000 lines per minute) and an 8088 Native Code Generator. Price: $1,995.

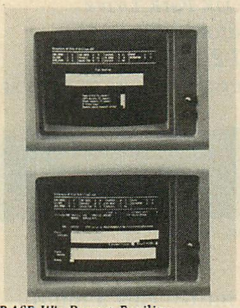
Micro Focus
2465 E. Bayshore Road
Palo Alto, CA 94303
415-856-4161

CIRCLE 475 ON READER SERVICE CARD

Ashton-Tate has introduced **dBASE III**, a new relational data base management software program designed for 16-bit and larger computers. Initially, the product will be available for IBM PCs or XTs with at least 256K and two disk drives or a hard disk. Features include storage capabilities of up to 2 billion records per file and 128 fields per data base. Ten data base files can be used simultaneously. Also offered are the ability to establish relations between files, full-screen report generation, and mailing label capability. A dBASE Assistant provides help with the commands for new users; this feature can be turned off when not needed. $695.

Ashton-Tate
10150 West Jefferson Blvd.
Culver City, CA 90230
213-204-5570

CIRCLE 482 ON READER SERVICE CARD



dBASE III's Report Facility

Microsoft Corporation has announced a new version of **Flight Simulator**, a real-time simulator program that puts the user in the pilot's seat of a Cessna 182. More detailed scenery and lifelike airplane performance features have been added, and support for RGB monitors is now provided. The program requires 46K of memory, one disk drive, and a color/graphics adapter. Price is $49.95.

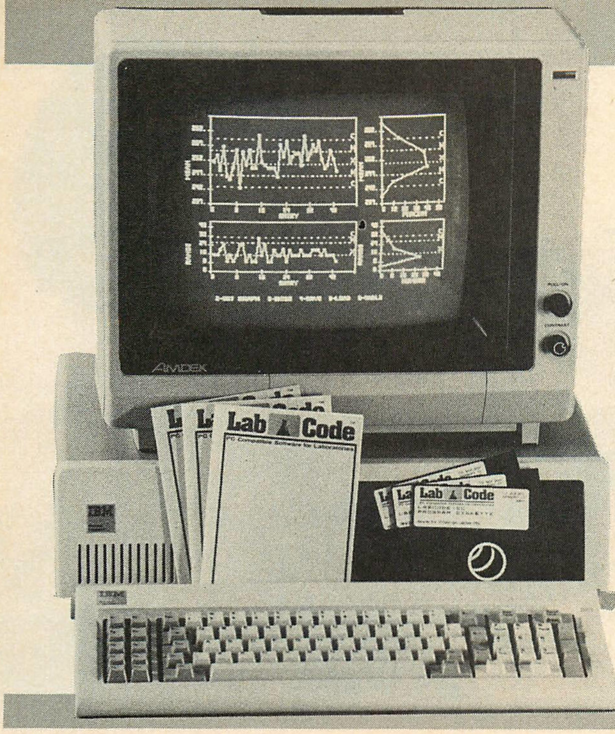
Microsoft Corporation
10700 Northup Way
Bellevue, WA 98009
206-828-2020

CIRCLE 481 ON READER SERVICE CARD

REA Computer Technology has introduced a new design lab for engineers and experimenters who would like to use Programmable Array Logic (PAL) technology. The PAL design lab consists of a programmer called **PALBLASTER**, that comes either in kit form or assembled, and a PAL compiler called **PALCMP.** The PALBLASTER uses an RS-232-C port and can program all AMD 20-pin PAL devices. PALCMP takes in PAL device specs in the form of equations and outputs a fuse map image. From $275 to $795, depending on the amount of assembly needed.

REA Computer
Technology
P.O. Box 1408
Almonte, Ontario
Canada K0A 1A0

CIRCLE 480 ON READER SERVICE CARD



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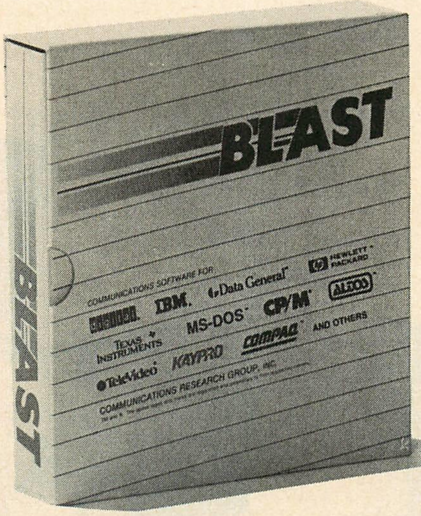

BLAST

SNA Exchange, a new integrated hardware/software package from **Intelligent Technologies**, unbundles the PC Exchange system's extensive range of PC-to-mainframe SNA emulation software from its asynchronous communications software and telephone management system. The SNA Exchange package provides IBM PC users with a wide variety of synchronous communications capabilities, including emulation of the IBM 3278/9 terminal, 3274 cluster controller, and 3287 (LU3) printer. $895.

Intelligent Technologies
151 University Avenue
Palo Alto, CA 94301
415-328-2411

CIRCLE 479 ON READER SERVICE CARD

Xi Systems Technology has announced its **DSNM**, a data distribution and global network communications utility. DSNM automatically dials and distributes data files and application programs to remote workstations. The software supports async, bisync, and SDLC protocols. It allows workstation users to load and execute interactive application programs at other workstations and permits remote job entry to the host mainframe computer. $395 for IBM PC license.

Xi Systems Technology
P.O. Box 46126
Cincinnati, OH 45246
513-771-6263

CIRCLE 477 ON READER SERVICE CARD

Xi Systems Technology's DSNM

LABCODE-QC, a statistical quality control system, has been announced by **Granada Systems Design**. The system produces a variety of different control charts, such as p, c, x-bar, range, cusum, and other Shewhart-type charts. As many as 12 different sets of data can be plotted simultaneously. Statistical parameters, including the mean, standard deviation, and minimum and maximum values, are calculated. $380.

Granada Systems Design
303 Fifth Avenue
New York, NY 10016
212-686-6945

CIRCLE 468 ON READER SERVICE CARD

BLAST, from **Communications Research Group, Inc.**, is an asynchronous communications package that provides truly bidirectional full duplex operation, allowing a system to receive one file while sending another. The BLAST protocol continuously interleaves unit blocks of data with check and acknowledgment blocks, thus minimizing delays because of echoes and noise. BLAST operates through RS-232-C ports and asynchronous modems, over dial-up lines or private networks, or from port to port over a direct connection at speeds up to 19.2 Kbps. $250.

Communications Research Group, Inc.
8939 Jefferson Highway
Baton Rouge, LA 70809
504-923-0888

CIRCLE 471 ON READER SERVICE CARD

Gateway Microsystems has introduced **Microgate/FT**, a file transfer package that employs the IBM Bisync communications protocol in an asyncronous PC-to-PC environment. Features include interactive, batch, and remote command modes, conversational message capability, error detection and loop control within batch command files, and built-in support for Hayes 300/1200 and Concord Data Systems CDS 224 auto-dial modems. $179.95 for two complete sets of software and documentation. $99.95 for additional single-unit kits.

Gateway Microsystems
9401 Capital of Texas Highway
Suite 105
Austin, TX 78759
512-345-7791

CIRCLE 478 ON READER SERVICE CARD

The new **DATABUS compiler** from **Sunbelt Computer Systems, Inc.** is designed for use with micros based on the Intel 8086/88 that use MS-DOS 2.0 or PC-DOS 2.0. This compiler can be used with most terminals. It generates assembler source from the DATABUS text, and when this code is assembled into absolute machine code, it results in significantly faster performance. $495.

Sunbelt Computer Systems
Suite 120
5525 East 51st Street
Tulsa, OK 74135
918-660-0670

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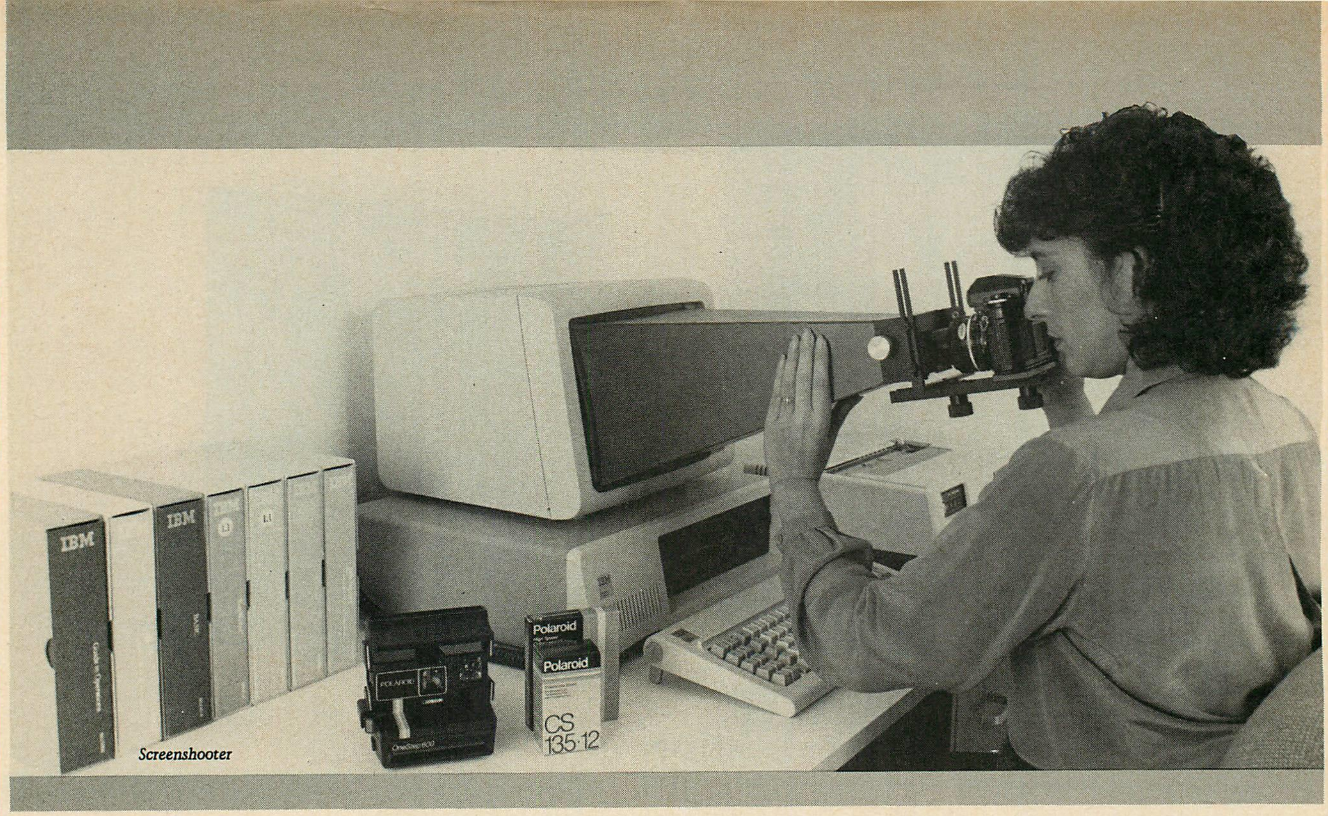


Screenshooter

A new programming language—**Plain English**—has been announced by **Command Language Systems, Inc.** Plain English employs a "building block" technique to create a unique, personalized vocabulary. Most users can become proficient in the language in only four hours. $595.

Common Language Systems
100 E. Sybelia Avenue
Maitland, FL 32751
305-628-5973

CIRCLE 474 ON READER SERVICE CARD

Orchid Technology has reduced the price of its **PCnet** local area network from $695 to $495. The company has also introduced a new PCnet advanced productivity software package, Version 2.4. PCnet uses a nondedicated server and can share IBM XT disk space. The network allows up to 256 users with more than 16 servers. The new software package gives PCnet faster and better performance.

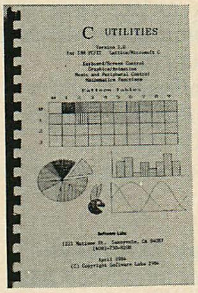
Orchid Technology
47790 Westinghouse Drive
Fremont, CA 94539
415-490-8586

CIRCLE 473 ON READER SERVICE CARD

Software Labs has introduced the **C Utilities Package** for the IBM PC/XT. This package enables C programmers to call functions for screen control, graphics, animation, and mathematical capabilities. In addition, it provides comprehensive omnibus I/O control for all of the IBM PC/XT peripherals. The package requires 128K, two disk drives, and a C compiler. $119.

Software Labs
1221 Matisse Street
Sunnyvale, CA 94087
408-730-8108

CIRCLE 470 ON READER SERVICE CARD



C Utilities

A new package from **Davong Systems, Inc.** allows the users of Davong's MultiLink local area network to read, create, and send mail to others on the network or to other local area networks. **LAN: Mail Monitor** is a fully networked electronic mail program that includes mail manager capabilities to add, delete, or change user and distribution lists and to monitor system usage. The LAN package includes an editor, an archive facility to save received letters, the ability to send data files with letters, and the ability to check on letters sent but currently undelivered. $695.

Davong also announced that a print spooler will be added to the software package accompanying the Davong MultiLink local area network. Current MultiLink users can add the print spooler to their LAN for a nominal upgrade charge.

Davong Systems, Inc.
217 Humboldt Court
Sunnyvale, CA 94089
408-734-4900

CIRCLE 472 ON READER SERVICE CARD

Introl Corporation has introduced a cross-software version of the Introl-C/6809 C language compiler system. The new cross-compiler, called **Introl p/n PC 6809**, permits the IBM PC to be used for developing programs in C for any 6809-based target. The package produces compact code that is re-entrant, relocatable, and ROMable. It can generate either position-dependent or position-independent code and data, and it has features that permit program segments to be selectively placed under any of 16 location counters. $200.

Introl Corporation
647 W. Virginia Street
Milwaukee, WI 53204
414-276-2937

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OTHER WARES

NPC Photo Division has come up with a device to take photographs of a CRT screen. **Screenshooter** uses Polaroid 600 high-speed color film, Polachrome 35mm instant slide film, or conventional 35mm color and black and white films. The outfit includes a Polaroid One-Step 600 camera, a CRT hood and adapter, diopter lens, and 35mm SLR camera bracket. $169.

NPC Photo Division
1238 Chestnut Street
Newton, MA 02164
617-969-4522

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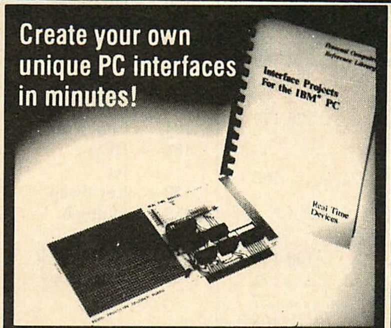

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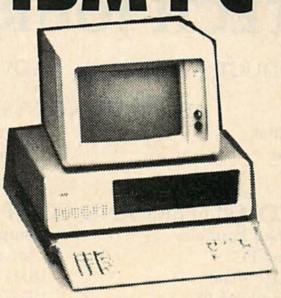

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cd	–change directory	**print**	–pr directed to printer
clear	–clear monitor screen	**pwd**	–print working directory
cmp	–compare files	**rm**	–remove files (delete)
comm	–output lines common to two files	**sh**	–shell (command interpreter)
cp	–copy files	**size**	–size of object code
cpio	–file backup/archival	**sort**	–sort numerically or alphabetically
date	–get or set date and time	**sum**	–checksum file
echo	–echo arguments to stdout	**tail**	–output last lines of file
expand	–expand tabs into spaces	**tee**	–pipe fitting
expr	–string and arithmetic evaluation	**test**	–test file's or string's characteristics
false	–do nothing, unsuccessfully	**time**	–determine time to execute a command
find	–produce list of selected files	**tr**	–translate or delete characters
grep	–search files for specified pattern	**true**	–do nothing, successfully
hd	–hex file dumper	**unexpand**	–replace spaces with tabs
head	–output 1st lines of file	**uniq**	–remove duplicate lines
ls	–sorted directory list	**wc**	–count chars, words and lines
more	–copy files to display	**words**	–output file 1 word per line
mv	–move files (rename)		

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Tampa, FL
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August 6-10
National Conference on Artificial Intelligence
Austin, TX
Sponsor: ACM and the American Association for Artificial Intelligence
Contact: J. M. Tenebaum, Conference Chairman, Artificial Intelligence Laboratory, Fairchild Camera and Instrument, 4001 Miranda, Palo Alto, CA 94304, 415-926-5001

August 21-24
1984 International Conference on Parallel Processing
Bellaire, MI
Sponsors: Ohio State University and IEEE
Contact: Conference on Parallel Processing, IEEE Computer Society, P.O. Box 639, Silver Spring, MD 20901

August 22-24
1984 ACM Sigmetrics Conference on Measurement and Modeling of Computer Systems
Cambridge, MA
Contact: Association for Computing Machinery, 11 West 42nd Street, New York, NY 10036

SEPTEMBER

September 3-5
IBM System User Show
London
Sponsor: IBM System User Magazine
Contact: EMAP International Exhibitions Ltd., 8 Herbal Hill, London, EC1R 5JB, England

September 6-9
CompuLearn: International Exposition and Conference on Computers in Education
Atlanta, GA
Sponsors: Expoconsul International, Inc. and A Better Way in cooperation with The United Negro College Fund
Contact: Expoconsul International Inc., 55 Princeton-Hightstown Rd., Princeton Junction, NJ 08550

September 11-14
UNIX Systems EXPO/84
Los Angeles, CA
Sponsor: Computer Faire, Inc.
Contact: David Sudkin, 617-965-8350; Alan Kucheck, 415-364-4294

September 12-14
Eurographics '84
Copenhagen
Sponsor: SIGGRAPH
Contact: DIS Congress Service, Linde Alle 48, DK-2720 Vanlose, Copenhagen, Denmark

September 16-20
COMPCON Fall
Arlington, VA
Sponsor: IEEE
Contact: IEEE, P.O. Box 639, Silver Spring, MD 20901

September 20-23
New York/Userfest
New York, NY
Sponsor: Northeast Expositions, 617-739-2000

September 24-25
World Conference on Ergonomics in Computer Systems
Los Angeles, CA
Contact: Crispin Littlehales or Rosemarie Burnett, Thomas L. Richmond, Inc., 1350 Avenue of the Americas, New York, NY 10019

September 24-26
PCExpo
Anaheim, CA
Contact: PCExpo Shows, 333 Sylvan Avenue, Englewood Cliffs, NJ 07632, 201-569-8542

September 27-30
5th Annual Mid-Atlantic Computer Show and Office Equipment Exposition
Washington, D.C.
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OCTOBER

October 8-10
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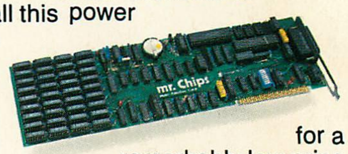

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